PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

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Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

[*Continued on page 3 of cover*

MATHEMATICS 51

512.831 : 530.145 713

Algebra related to elementary particles of spin ⅜. MADHAVDRAO, B. S., THIRUVENKATACHAR, V. R., AND VENKATACHALIENGAR, K. *Proc. Roy. Soc. A*, **187**, 185–97 (*Nov.* 5, 1946).—The algebra investigated is that generated by the 4 matrices β_l occurring in the relativistic wave equation for a particle of arbitrary spin, $(\partial_l\beta_l + \chi)\psi = 0$. Matrices η_l, satisfying $\eta_l^2 = 1$, $\eta_l\beta_j + \beta_j\eta_l = 0$ $(i \neq j)$, and $\eta_\mu\beta_\mu = \beta_\mu\eta_\mu$, are introduced and it is shown that these are polynomials in the β_l. Next, quantities $\xi_l = \eta_l\beta_l$ are defined, and, for half odd integral spin, the ξ's and η's form 2 mutually commuting sets of symbols, with the η's obeying the same commutation rules as the Dirac matrices. Thus the algebra for half odd integral spin is the direct product of the Dirac algebra and an associated ξ–algebra. For a maximum spin of ⅜ the ξ–algebra has only 3 representations of orders 1, 4, 5, such that $1^2 + 4^2 + 5^2 = 42 =$ rank of the algebra. Explicit representations are given in the case of orders 4 and 5. The 4-row representation of the ξ's gives a representation of the β's of order 16 which is likely to be important in Bhabha's new theory of the protons. L. S. G.

513.8 714

On the dimension of normal spaces. ALEXANDROFF, P. *Proc. Roy. Soc. A*, **189**, 11–39 (*March* 27, 1947).

517.512.4 715

Expansions in series of Bessel functions of the second kind. II. OLSSON, H. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 2) *Paper* 12, 12 *pp.* (1946).—Expansions of the form $F(z) = \sum A_n K_n(z)$ are investigated. Let

$$F(ze^{2\pi i}) - F(z) = 2\pi i\psi(z)$$

A necessary and sufficient condition is found for expanding $\psi(z)$ into a series of Bessel functions, $I_n(z)$. Various properties of $F(z)$ and $\psi(z)$ are established and integral formulae are derived. L. S. G.

517.564.3 : 518.2 716

Table of the Bessel functions and derivatives, J_2, J_1', J_2', N_2, N_1', N_2'. DWIGHT, H. B. *J. Math. Phys.*, **25**, 93–5 (*May*, 1946).

517.7 : 518.2 717

Table of the Struve functions $L_\nu(x)$ and $H_\nu(x)$. *J. Math. Phys.*, **25**, 252–9 (*Oct.*, 1946).

518.2 : 517.564.3 *see Abstr.* 716

518.2 : 517.7 *see Abstr.* 717

518.5 718

The relay interpolator. CESAREO, O. *Bell Lab. Rec.*, **24**, 457–60 (*Dec.*, 1946).—Describes a computing machine using telephone type relays and teletype tape reading and punching equipment designed primarily to perform interpolation calculations associated with any given set of numerical data. Other types of calculation have, however, been performed. The machine uses a bi-quinary number notation, and details of the adding circuit are given, together with an indication of the way in which subtraction and multiplication are performed. The accuracy of the machine is equivalent to 5 significant decimal digits, and the sequence of operations is controlled by a teletype tape which may be punched to perform a variety of calculations. P. O.

518.5 719

A rotary periodograph. MONCRIEFF-YEATES, G. B. *J. Sci. Instrum.*, **24**, 35–40 (*Feb.*, 1947).—The apparatus described has been designed for the rapid analysis of disturbed periodic functions. A "bi-ordinate" method of analysis is adopted in which the variance of the sum of two ordinates is plotted against their separation to produce a "characteristic curve" containing many of the constants required. The variance is obtained as the square of the voltage output from the amplifier of a photocell receiving light from two slits of variable separation scanning a silhouette of the function. A.

518.5 : 548.735/.74 720

The use of punched cards in molecular structure determinations. I. Crystal structure calculations. II. Electron diffraction calculations. SHAFFER, P. A., JR., SCHOMAKER, V., AND PAULING, L. *J. Chem. Phys.*, **14**, 648–64 (*Nov.*, 1946).

518.5 : 621.317.757.087 721

A new electronic analyzer. BALDOCK, G. R., AND WALTER, W. G. *Electronic Engng*, **18**, 339–44 (*Nov.*, 1946).—[Abstr. 955 B (1947)].

519.2 : 578.088.5 *see Abstr.* 1083

519.21 : 539.431 *see Abstr.* 1018

519.213 : 621.317.755 722

Random fluctuations in a cathode-ray oscillograph. CAMPBELL, N. R., AND FRANCIS, V. J. *Phil. Mag.*, **37**, 289–310 (*May*, 1946).—[Abstr. 954 B (1947)].

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.042 : 523.112 : 539.17 *see Abstr.* 982

521.042 : 523.877 : 539.17 *see Abstr.* 981

521.042 : 539.17 *see Abstr.* 980

521.2 723

Conditions of plane orbits in classical and relativistic fields. NARLIKAR, V. V., AND KARMARKAR, K. R. *Proc. Indian Acad. Sci. A*, **24**, 451–5 (*Nov.*, 1946).—The most general classical field of force for which the orbit of a test-particle is invariably plane has been discovered. If the relativistic equations of a test-particle are interpreted in the classical sense, a general result is obtained, of which a particular case accounts for the orbit of Mercury being plane even according to relativistic mechanics. W. R. A.

522.22 : 535.317 724

An aplanatic anastigmatic lens system suitable for astrograph objectives. STRÖMGREN, B. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **23** (*No.* 9) 27 *pp.* (1945).

522.614.3 = 4 725

Stereoscope for measures of astronomical photographs. RÖSCH, J. *Rev. Opt.* (*Théor. Instrum.*) **24**, 161–6 (*July-Sept.*, 1945) *In French.*—This micrometer is suitable for the determination of stellar proper motions, magnitudes and effective wavelengths. The accuracy obtainable is given for both trained and untrained operators. E. G. M.

523.11 : 530.12 *see Abstr.* 739

523.112 : 521.042 : 539.17 *see Abstr.* 982

523.14 : 523.161 : 523.852.31 *see Abstr.* 731

523.161 : 523.14 : 523.852.31 *see Abstr.* 731

523.161 : 523.823 : 523.852.31 *see Abstr.* 732

523.5 : 621.396.99 726

Detection of meteors by radio. MANNING, L. A., HELLIWELL, R. A., VILLARD, O. G., AND EVANS, W. E. *Phys. Rev.*, **70**, 767–8 (*Nov.* 1 *and* 15, 1946).—Reflection of radio waves from meteor trails were examined with a 15 Mc/s 100 kW broadcasting station, and a 29 Mc/s 0·7 kW continuous transmitter. Doppler whistles on both frequencies were often accompanied by a burst of signal strength. Even when the Doppler whistle could only be heard on the high-power frequency, coincident bursts of signal strength occurred on the low power, indicating that meteors can be detected by a low-power continuous wave transmitter. W. E. D.

523.531 : 621.396.96 727

Radar observations during meteor showers 9 October 1946. BATEMAN, R., MCNISH, A. G., AND PINEO, V. C. *Science*, **104**, 434–5 (*Nov.* 8, 1946).

523.746 : 551.590.21 = 3 728

Sunspots and their terrestrial effects. WALDMEIER, M. *Experientia*, **2** (*No.* 9) 354–61 (1946) *In German.*—Chiefly an account of earlier work, including a discussion of Alfvén's theory. A relation connecting the rapidity of onset of a new solar cycle with the cycle's intensity is used to predict that the present cycle will be very intense. Radiation responsible for the ionosphere is ascribed to hot regions in the corona, due to electric fields near an increasing sunspot. Bartels' *M*-regions are identified with stationary prominences. T. G. C.

523.77 : 551.521.1 729

Solar ultraviolet spectrum to 88 kilometres. BAUM, W. A., JOHNSON, F. S., OBERLY, J. J., ROCKWOOD, C. C., STRAIN, C. V., AND TOUSEY, R. *Phys. Rev.*, **70**, 781–2 (*Nov.* 1 *and* 15, 1946).—A vacuum spectrograph installed in a V 2 rocket recorded the sun's spectrum up to a height of 88 km. Results showed a general extension of the spectrum into the ultra-violet with height, extending to about 2 400 Å. The ozone layer was largely penetrated. W. E. D.

523.775.2 730

Intensities of hydrogen $H\alpha$ and helium D_3 in solar prominences. III. BRÜCK, H. A., AND MOSS, W. *Mon. Not. R. Astr. Soc.*, **105** (*No.* 5) 282–6 (1945).—The effect of internal excitation variations within a particular prominence is studied by tracing the variation in the intensity ratio R of these lines over 123 measured points. Two sets of isophotes based on equivalent widths are constructed. R is constant at 42 over one part of the prominence, but is variable in a region where the isophotes show a condensation above the chromosphere and where the negative density gradients are more pronounced in H than in He. A. HU.

523.823 : 523.161 : 523.852.31 *see Abstr.* 732

523.852.31 : 523.161 : 523.14 731

On the structure of disk-shaped extragalactic nebulae. I. On the temperature of interstellar material and the shapes of the nebulae. HOYLE, F. *Mon. Not. R. Astr. Soc.*, **105** (*No.* 5) 287–302 (1945).—On observational grounds the combined mass of the stars in a nebula is taken as less than the total mass of the interstellar material. The latter is composed mainly of H and other gases, but partly also of dust capable of radiating energy. It will form a flat rotating disc of which the plane perpendicular to the axis of rotation and of which th thickness is about 0·01 of its radius. The thickness shown to depend on the temperature distribution of th gaseous material, which is investigated by considering th radiation of the interstellar dust, of the interstellar H an of a mixture of the two. The temperature of the I cannot be kept as high as 10 000° by stellar radiatio alone. The average accelerations arising from ga pressure gradients in the plane of the disc are sma compared with the gravitational accelerations, so tha rotational instability does not occur. The interstella matter is more closely concentrated to the central plan than the stars, which must have acquired large peculia velocities perpendicular to the plane, especially near th nucleus. Collisions with globular clusters may be th source of these. A. HU.

523.852.31 : 523.161 : 523.823 73

On the structure of disk-shaped extragalactic nebulae II. On the condensation of stars, the luminosity function and the distribution of bright stars. HOYLE F. *Mon Not. R. Astr. Soc.*, **105** (*No.* 5) 302-19 (1945).—Th condensation of stars from a disc of interstellar materia in equilibrium is discussed. The temperature must b very low (*c.* 100°A) for condensation. The angula momentum of a condensation is so large that rotationa stability will exist only if the star is formed in a specia region where the differential rotation is unusually smal or if accretion occurs on a large scale. The discussion is applied to explain the general form of the luminosity function and the origin of the bright ring of stars in the outer regions of many nebulae. The theory leads to a general account of the distribution of giant stars, which explains many features of the observed spiral arms. A. HU.

523.854 733

Magnetic field of the galaxy. SPITZER, L. *Phys. Rev.*, **70**, 777–8 (*Nov.* 1 *and* 15, 1946).—Calculations on the galactic electric current indicate a resultant magnetic field of the order of 10^{-12} gauss. The bearing of these calculations on star formation is discussed. W. E. D.

523.877 734

On the radiative equilibrium of a stellar atmosphere. XI. CHANDRASEKHAR, S. *Astrophys. J.*, **104**, 110–32 (*March*, 1946).—[See Abstr. 2465 (1946)]. A partially-polarized radiation field without axial symmetry is contemplated and the transfer equations established, allowing for Rayleigh scattering. The equations for the case of the diffuse reflection of a parallel beam of unpolarized radiation by a semi-infinite plane-parallel atmosphere are solved to the nth approximation. G. C. McV.

523.877 735

On the radiative equilibrium of a stellar atmosphere. XII. CHANDRASEKHAR, S. *Astrophys. J.*, **104**, 191–202 (*March*, 1946).—[See Abstr. 2464 (1946)]. The problem of the diffuse reflection of radiation by a semi-infinite plane-parallel atmosphere is solved, allowance being made for the anisotropy of the scattered radiation. The phase function now considered is one which is expressible as a finite series of Legendre polynomials of the cosine of the angle of scattering. G. C. McV.

523.877 : 521.042 : 539.17 *see Abstr.* 981

523.877 : 530.12 : 531.26 *see Abstr.* 755

525.6 736

Absolute axes and tidal forces. WATSON, A. G. D. *Nature, Lond.*, **159**, 233 (*Feb.* 15, 1947).

A summary of dimensional analysis. LANGHAAR, H. L. *Franklin. Inst.*, **242**, 459–63 (*Dec.*, 1946).—Dimensional nalysis is treated as the mathematical theory of a class f functions characterized by a generalized type of omogeneity. It is felt that this treatment most clearly hibits its scope, and avoids philosophical controversy. A.

FUNDAMENTALS 530.1

30.12 738

Special relativistic field theories in five dimensions. COR- EN, H. C. *Phys. Rev.*, **70**, 947–53 (*Dec.* 1 *and* 15, 1946).— view of the current use of a 5-dimensional manifold for e development of general relativistic unified field eories, special relativistic theories of pure fields are here pressed in terms of an extra dimension. According to ese theories the rest-mass of a particle is not an arbit- ary parameter, constant under all conditions; it appears the equations as an operator. The Lagrangian ensities and equations of motion assume a simpler form an in the usual treatment, and the extra elements of the nergy tensor which appear may be given a consistent hysical significance. The unified vector-pseudo-scalar eory of mesons is a particular case of the fields here onsidered. The preliminary equations for the descrip- on of a pseudo-scalar-vector electromagnetic field are lso written down. The pseudo-scalar part cannot be sed in general to describe gravitational interaction pproximately in special relativity theory. A.

30.12 : 523.11 739

Time-scales in relativity. WALKER, A. G. *Proc. Roy. oc. Edinb. A*, **24** (*Part II*) 221–8 (1946).—Time-scales in inematical relativity are considered, when the Rieman- ian space-times employed have constant spatial curva- ure. Gravitational time (τ-time) is taken as basic, with espect to which the system of fundamental particles are t mutual rest relative to the definition of distance mployed in kinematical relativity. An absolute τ-time an be defined in terms of which $c = 1$ and the curvature onstant has the value ± 1. Conventional time-scales re proportional to this absolute one. Atomic (or inematic) t-time is then defined as that in terms of which he fundamental particles have uniform relative motion. o account for the red-shift it is necessary to introduce n axiom stating that periodic phenomena at each undamental particle have a constant frequency in t-time. he case of a flat spatial space-time is also treated, and he paper concludes with explicit formulae for observables uch as red-shift, distance from apparent size and from pparent brightness, number counts of nebulae, etc., in arious model universes. G. C. McV.

530.12 : 523.877 : 531.26 *see Abstr.* 755

530.14 740

On the field theory of nuclear forces. MØLLER, C., AND ROSENFELD, L. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, 17 (*No.* 8) 72 *pp.* (1940).—In Part I a method of canonical ransformation is used to effect the separation of a "static" nteraction between nuclear particles. This interaction s defined to be that part of the interaction which is btained upon neglecting the time-variations of the ariables denoting the positions, spins and isotopic pins of the heavy particles. There are 3 types of static nteraction potentials, a spin-independent potential, a pin-spin coupling and a directional coupling of the type of a dipole interaction. Expressions for these potentials are derived for each of the 4 types of meson fields, scalar, vector, pseudoscalar and pseudovector. Part II is concerned with the limitations of the various meson fields and the choice of a meson theory which best fits certain experimental facts. The difficulties arising from a potential of the dipole interaction type are discussed, and known properties of the stationary states of the deuteron are used to impose restrictions on the static potentials. Thus the static potential must be attractive in the ^3S and ^1S states of the deuteron, and the ^3S-level must be lower than the ^1S level. If we assume Kemmer's symmetrical combination of charged and neutral fields [Abstr. 1760 (1938)], the conditions are sufficient to single out a unique possibility, namely a mixture of a vector meson field and a pseudoscalar meson field. In Part III this theory is applied to the stationary states of the deuteron, and the electric quadrupole moment of the ground state is calculated. For a continuation of the theory see Abstr. 741 (1947). L. S. G.

530.14 741

On the theory of mesons. MØLLER, C. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No.* 6) 46 *pp.* (1941).—A continuation of previous work [Abstr. 740 (1947)]. The aim is to reduce the number of arbitrary constants in the mixed meson theory. It is shown that the vector and pseudoscalar field equations may be comprised in a 5-dimensional representation which is invariant under all rotations of 5-dimensional space, provided certain relations hold between the constants in the equations. These effectively reduce the number of constants from 4 to 2. A physical interpretation of the field equations of the meson theory in de Sitter space is given. The equations of motion are written in Hamiltonian form and expressions are derived for the static interaction potential. The electric quadrupole moment of the deuteron is calculated, and the order of magnitude is the same as that found by experiment [Abstr. 1830 (1940)]. L. S. G.

530.14 742

Undor representation of the five-dimensional meson theory. NØRLUND, I. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **19** (*No.* 9) 29 *pp.* (1942).—An *undor* is a quantity which, under Lorentz transformations, behaves like a product of Dirac wave-functions (4-spinors). The simplest properties of 4- and 5-dimensional undors are developed, and the undors are expressed by means of the tensor field quantities. The undor field equations of the symmetrical theory of Møller and Rosenfeld [Abstr. 740 (1947)] and of the neutral meson theory of Bethe [Abstr. 1329 (1940)] are set up. It is shown that for the symmetrical theory the field equation may be derived from a variational principle, but this is not possible for the neutral theory. This is taken as signifying a strong preference for the former theory. In this theory the wave equations of the nucleons and the expression for the current vector are derived. L. S. G.

530.14 743

Representation of single particle operators in two-particle form. FEENBERG, E. *Phys. Rev.*, **70**, 768–9 (*Nov.* 1 *and* 15, 1946).—Two of the illustrations given are expressions representing (i) the internal kinetic energy of any number of isobaric particles in terms of the relative kinetic energy of pairs of particles; (ii) internal orbital angular momentum of an assembly of particles in terms of the relative angular momentum of pairs of particles. W. E. D.

530.14 = 3 744

The energy-momentum tensor of a field theory with action-at-a-distance. BOPP, F. *Z. Naturforsch.*, **1**, 238–42 (*May*, 1946) *In German.*—In a linear theory of this type the field equations are generalizations of the form $\int \epsilon_0(x - x')\varphi(x')dx' = 0$ with suitable kernels ϵ_0. A method of deriving the energy tensor is given which is more suitable with such fields than the standard methods. G. J. K.

530.14 : 537.123 745

Properties of mesons described by a pseudoscalar wave-function. CHANG, T. S. *K. Danske Vidensk. Selsk. Mat-fys. Medd.*, **19** (*No.* 10) 17 *pp.* (1942).—The processes considered are: (1) the absorption of a meson, on hitting a nucleon, with emission of a light quantum; (2) elastic scattering of mesons by nucleons; (3) a meson hitting a nucleon and creating a pair of mesons. The lifetime of a pseudoscalar meson is also evaluated. Numerical estimates of the probabilities and the corresponding cross-sections are given. L. S. G.

530.14 : 538.11 = 3 746

On the theory of isolated magnetic poles. BANDERET, P. P. *Helv. Phys. Acta*, **19** (*Nos.* 6–7) 503–22 (1946) *In German.*—Dirac [Abstr. 340 (1932)] proved from consideration of the phase of the ψ-function the possibility of the existence of isolated quantized magnetic poles. Tamm [Abstr. 341 (1932)] and Fierz [Abstr. 1369 (1944)] studied the motion of an electron in a magnetic Coulomb field applying the non-relativistic Schrödinger equation. The Fierz eigen-functions are applied in the first part of the present paper to the study of the scattering of charged particles by a magnetic pole, the result being substantially the same as that of the classical theory. In the second part, the bound states of a charged particle in a magnetic Coulomb field are investigated on the basis of Dirac's relativistic wave equation. Stationary states are found to be impossible if the particle has an additional magnetic moment besides that to be expected if it obeys Dirac's equation (protons). Bound states are possible for electrons: the corresponding eigen-functions are given explicitly. L. P.

530.14 : 538.3 : 537.122 747

Some applications of the Riesz potential to the theory of the electromagnetic field and the meson field. FREMBERG, N. E. *Proc. Roy. Soc. A*, **188**, 18–31 (*Dec.* 31, 1946).—The method of Riesz, a process of analytic continuation, is applied to the wave equation, and various divergence difficulties are thereby avoided. In the theory of the electromagnetic field the method yields the classical retarded potential. The proper energy and proper momentum of an electron in the field are investigated, and results recently obtained by Dirac [Abstr. 3360 (1938)] are now obtained without any new assumptions. These include the Lorentz–Dirac equations of motion. The corresponding problem in Bhabha's analogous theory for the neutral meson field is investigated, and expressions are derived for the meson field energy and momentum for a particle in uniform motion. L. S. G.

530.145 748

The problem of quantization of higher order equations. RAYSKI, G. *Phys. Rev.*, **70**, 573–4 (*Oct.* 1 *and* 15, 1946).

530.145 749

Second quantization and representation theory. CORSON, E. M. *Phys. Rev.*, **70**, 728–48 (*Nov.* 1 *and* 15, 1946).—The formalism of the second quantization is developed entirely within the framework of the Dirac–Jordan representation theory. The equivalence of this formalism and the methods of ordinary co-ordinate-spin space is shown, and the equations of "connection" are fully developed. It is shown that the "creation" and "annihilation" operators, and indeed all operators which do not commute with the quantized Hamiltonian and hence whose representatives cannot be explicitly given in a configuration space of a fixed number of dimensions, are easily treated in terms of the general representation theory and arise quite naturally. Both types of statistics are considered, and the Fock–Dirac density matrix and self-consistent field are treated as a simple illustration.

530.145 : 512.831 *see Abstr.* 713

530.145 : 539.152.1 = 3 75

Mass defect of atomic nuclei and the relativistic many-body problem. BAGGE, E. *Z. Naturforsch.*, **1**, 361–(*July*, 1946) *In German.*—The relativistic Lagrangian including terms up to the second power of v/c, is given for an assembly of particles, and from this is derived the mass defect of the system. An approximate relativistic wave equation for a 2-particle system is also obtained. W. E. D.

530.145.6 : 539.152.1 *see Abstr.* 940

530.145.63 75

On the redundant zeros in the theory of the Heisenberg matrix. TER HAAR, D.; JOST, R. *Physica, 's Grav.* **12**, 501–10 (*Nov.*, 1946).—[See Abstr. 2481 (1946)].

530.145.63 752

A supplementary condition in Heisenberg's theory of elementary particles. KRONIG, R. *Physica, 's Grav.*, **12**, 543–4 (*Nov.*, 1946).

530.145.63 753

Remarks on Dr. Ma's "Redundant zeros in the discrete energy spectra in Heisenberg's theory of characteristic matrix." OPECHOWSKI, W. *Phys. Rev.*, **70**, 772 (*Nov.* 1 *and* 15, 1946); MA, S. T. *ibid.*, **71**, 210 (*Feb.* 1, 1947).—[See Abstr. 2481 (1946)]. It is contended that there are no redundant zeros in the case under consideration. Ma replies to this criticism. W. E. D.

530.162 : 535.23.08 *see Abstr.* 799

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.259.1 : 539.4.011.25 754

The opening of a Griffith crack under internal pressure. SNEDDON, I. N., AND ELLIOTT, H. A. *Quart. Appl. Math.*, **4**, 262–7 (*Oct.*, 1946).—An analysis is made of the distribution of stress in the neighbourhood of a Griffith crack subject to an internal pressure, which may vary along the length of the crack. A Fourier cosine transform method is used. A method is given for finding the shape of the crack resulting from the application of a variable internal pressure to a very thin crevice in the interior of an elastic solid, and for finding the stress distribution throughout the solid. As an example, expressions for the stress components due to the opening of a crack under a uniform pressure are derived. L. S. G.

531.26 : 530.12 : 523.877 755

Schwarzschild interior solution. ROSEN, N., AND NEWMAN, B. *Phys. Rev.*, **70**, 565–6 (*Oct.* 1 *and* 15, 1946).—A modification to Wyman's treatment [Abstr. 2778 (1946)] is suggested, which makes it equivalent to Schwarzschild's, and the two both give the same value for the true radius of the sphere.

531.3 756

On the transformation of the equations of dynamics. THOMAS, T. Y. *J. Math. Phys.*, **25**, 191–208 (*May*, 1946).—Let D and E be 2 Lagrangian systems referred to generalized co-ordinates $x^1, x^2, \ldots x^n$ and $y^1, y^2, \ldots, y^n$. Conditions are found in order that there exist a (1,1)

respondence $x \longleftrightarrow y$ between the co-ordinates, by ns of which all trajectories of D will be mapped into ectories of E and conversely. This problem is of portance in non-linear mechanics. L. S. G.

.31 : 539.501 *see Abstr.* 1019

.382 757

The production of high centrifugal fields. BEAMS, J. W., UNG, J. L., AND MOORE, J. W. *J. Appl. Phys.*, **17**, –90 (*Nov.*, 1946).—A description of the methods and ension of the results given in Abstr. 2264 (1946).

.44 : 532.516 : 539.62 758

Kinetic friction in or near the boundary region. I. Apatus and experimental methods. CHALMERS, B., RRESTER, P. G., AND PHELPS, E. F. *Proc. Roy. Soc. A*, , 430–9 (*Dec.* 13, 1946).—Two methods of obtaining tively pure boundary friction are discussed. These : (1) to ensure that only sufficient lubricant is present provide a boundary film; (2) to control the conditions load, speed and contact area so that fluid film formaon does not occur. Apparatus is described which uses thod (2). One specimen is driven at a fixed velocity, d a second is applied to it by a dead load. The force quired to restrain the second specimen is measured by lancing against a variable dead load. Instability is ppressed by fluid damping. The coefficient of friction thus read directly by a null method. Results may be produced to within about 10%. L. S. G.

1.44 : 532.516 : 539.62 759

Kinetic friction in or near the boundary region. II. The luence of sliding velocity and other variables on kinetic ction in or near the boundary region. FORRESTER, P. G. *oc. Roy. Soc. A*, **187**, 439–63 (*Dec.* 13, 1946).—Tests ere made upon a wide range of materials: (1) with no brication, (2) with lubricant films of varying thickness,) with rubber. Friction/velocity curves were obtained each case. The variation of friction with velocity may derived from at least 3 sources: (1) properties of the ean metal surfaces, (2) partial destruction of the oundary film, (3) fluid-film effects which may occur hen there is excess of lubricant. Each of these is amined carefully. L. S. G.

1.44 : 532.516 760

Kinetic boundary friction. BRISTOW, J. R. *Proc. Roy. oc. A*, **189**, 88–102 (*March* 27, 1947).—It is shown that e exhibition of smooth sliding and relaxation oscillaons, or "stick-slips," under conditions of boundary ubrication, when frictional forces are measured by the eflection of an elastic system, may be explained as due the dependence of kinetic friction on velocity, and iding under boundary conditions is never inherently iscontinuous. In the cases giving smooth sliding, kinetic iction decreases as velocity decreases, at very low speeds; or the cases giving relaxation oscillations kinetic friction ncreases as velocity decreases. Curves of boundary iction against velocity, using various sliding surfaces, ave been determined for a number of lubricants, which how both the above-mentioned types of friction-velocity elationship; and the dependence is shown of kinetic oundary friction on molecular weight for a series of sters of the fatty acids, on percentage of fatty oil in a ompounded lubricant (actually oleic acid in mineral oil) nd on temperature for a pure substance and a mineral il. The measurements with the series of esters show ome agreement with results given by Fogg [Abstr. 1019 1940)]. The mixtures of oleic acid with mineral oil give lecreasing kinetic friction with increasing percentage of leic acid right up to 100% oleic acid. The effect of temerature on the dependence of friction on velocity shows hat the temperature at which relaxation oscillations first occur depends on the speed of sliding, from which it appears that measurements of the temperature at which relaxation oscillations start at constant sliding speed [Abstr. 3008 (1942)] are not a measure of the temperature at which there is a discontinuity in the properties of the boundary layer. A.

MECHANICAL MEASUREMENTS 531.7

531.717 : 548.73 *see Abstr.* 1044

531.787 : 534.222.2 *see Abstr.* 786

531.787.4 : 551.46.018.2 *see Abstr.* 1064

531.788.7 : 533.51 *see Abstr.* 776

531.789.1 : 621.317.788 761

Electromagnetic torquemeter. HIVELY, M. W., AND LIVERMORE, D. F. *Trans. Amer. Soc. Mech. Engrs*, **68**, 723–7 (*Oct.*, 1946).—[Abstr. 689 B (1947)].

MECHANICS OF LIQUIDS 532

532.122 762

The adiabatic compressibility of liquids. RAMA RAO, M. *J. Chem. Phys.*, **14**, 699 (*Nov.*, 1946).

532.13 763

The effect of an electric field on the viscosity of liquids. ANDRADE, E. N. DA C., AND DODD, C. *Proc. Roy. Soc. A*, **187**, 296–337 (*Nov.* 5, 1946).—In the apparatus used, the liquid runs in a narrow channel between plane metal boundaries which are used as electrodes. Fields up to an average strength of 35 kV/cm may be used. With non-polar liquids or non-conducting polar liquids a field transverse to the line of flow has little effect. With polar liquids the field causes a considerable increase in apparent viscosity. The effect increases with increasing field strength to a limiting value, but only changes with frequency above a certain critical frequency, when a decrease occurs. The critical frequency decreases as the inter-electrode distance increases, and increases with temperature. There is no effect with a field parallel to the lines of flow. A theory of these phenomena is given. It is suggested that the effect is due to the accumulation of ions near the electrodes, and the ions act as centres round which polar molecules cluster. L. S. G.

532.13 : 536.413 : 666 764

Viscosity and the extraordinary heat effects in glass. TOOL, A. Q. *J. Res. Nat. Bur. Stand., Wash.*, **37**, 73–90 (*Aug.*, 1946).—Discusses viscosity of glass in the annealing range, referred to actual and "equilibrium" or "fictive" temperatures, in relation to exothermic effects shown on heating chilled samples, and thermal expansion properties. An analysis is based on the equation: $d\tau/dt = K_T(T - \tau)$, giving the rate of approaching equilibrium in terms of the actual temperature T and the fictive temperature τ, K_T being a factor inversely proportional to the viscosity. The theory is applied to the question of thermal expansion in this temperature region on the assumption that viscosity is a function of τ as well as of T. Estimates are also made of heat effects from equilibrium temperatures obtained from thermal expansion curves. Reasonable agreement with experiment is suggested. Results are discussed in terms of thermal and intrinsic pressures and other data on structure of glass. G. O. J.

532.516 : 531.44 *see Abstr.* 760

532.516 : 539.62 : 531.44 *see Abstr.* 758, 759

532.517.3 765

Stability of viscous flow between rotating cylinders. II. Cylinders rotating in opposite directions. MEKSYN, D.

Proc. Roy. Soc. A, **187**, 480–91 (*Dec.* 13, 1946).—The solution obtained in a previous paper [Abstr. 223 (1947)] is extended to the case where the cylinders rotate in opposite directions. The spacings of the vortices and the critical angular speed of the inner cylinder are found. The agreement with Taylor's experimental results [Abstr. 1518 (1923)] is good, but depends greatly upon the accuracy of the measurement of the radius of the inner cylinder when the distance between the cylinders is small and the ratio of the speeds of the cylinders is large. L. S. G.

532.517.3 766

Stability of viscous flow between rotating cylinders. III. Integration of a sixth order linear equation. MEKSYN, D. *Proc. Roy. Soc. A*, **187**, 492–504 (*Dec.* 13, 1946).—The asymptotic integrals of the differential equation arising in the theory [Abstr. 765 (1947)] are derived. When the cylinders rotate in opposite directions the integrals become infinite at approximately the point where the mean velocity of rotation is zero. The asymptotic expansions change their form in passing through this point, and the transformation law is obtained. L. S. G.

532.525 767

The break-up of liquid jets. MERRINGTON, A. C., AND RICHARDSON, E. G. *Proc. Phys. Soc., Lond.*, **59**, 1–13 (*Jan.*, 1947).—Experiments have been carried out with fixed nozzles and with moving nozzles (attached to an aircraft) discharging backwards into the atmosphere. A relation expressing drop size in terms of viscosity and the relative velocity between jet and surrounding air, applicable to both cases, is given. At low velocities this relation ceases to apply, and drop size reaches a limiting value. Factors influencing this limiting figure are discussed; information has also been obtained on the stability of large drops. Measurements made on the length of the jet confirm the work of Tyler and Richardson [Abstr. 2421 (1925)], but also disclose a hitherto unsuspected anomaly in the case of very viscous liquids. Similar results were obtained when a jet issued into another liquid with which it did not mix, but showed the effect of the relative viscosity of the liquids on the break-up. A.

532.593 768

Sea waves. UNNA, P. J. H. *Nature, Lond.*, **159**, 239–42 (*Feb.* 15, 1947).

532.593 : 551.46 *see Abstr.* 1063

CAPILLARITY 532.6

532.61 769

A dynamical determination of adhesion tension. ELEY, D. D., AND PEPPER, D. C. *Trans. Faraday Soc.*, **42**, 697–702 (*Nov.*, 1946).

532.61 : 541.183 = 4 *see Abstr.* 1026

532.62 : 532.72 770

Two-dimensional transport at fluid interfaces. CRISP, D. J. *Trans. Faraday Soc.*, **42**, 619–35 (*Sept.–Oct.*, 1946).—By means of a new technique, rates of flow and surface pressure gradients are measured simultaneously on moving films. Experiments were carried out to demonstrate the influence of various mechanical constraints, the viscosity of the substrate, and the type of film employed. The results agree with those predicted by hydrodynamical calculations based on the assumption that the film flows as a continuous sheet bound to the water. No evidence was found for molecular streaming or for "slip" across the substrate, even at the lowest surface pressures employed with liquid and vapour films. Since surface diffusion is normally masked by surface flow, the dimensional Fick equation is not applicable at a mo interface and an equation for 2-dimensional flow m replace it. The relation between the two equation given and the conditions under which true diffusion mi be observed are discussed.

KINETIC THEORY OF LIQUIDS 532.7

532.7

A general kinetic theory of liquids. I. The molecu distribution functions. BORN, M., AND GREEN, H. *Proc. Roy. Soc. A*, **188**, 10–18 (*Dec.* 31, 1946).—A set equations is derived which describes both the equilibri of a statistical assembly of molecules and the dynami properties. The method is to introduce, not a sin distribution function, as in the kinetic theory of gas but a complete set of such functions for single doublets, triplets, etc., of molecules, and, depending the position, velocity and higher time-derivatives. T generalized continuity equations satisfied by the functions are derived, and by using the equations motion a set of relations which determine the distributi functions is obtained. Boltzmann's equation in t kinetic theory of gases follows as a particular case, and equilibrium conditions the theory gives results consiste with statistical mechanics. An integral equation for t radial distribution function is obtained. L. S.

532.7 : 533.7 7

Phenomenological theory of transport processes in fluic LEAF, B. *Phys. Rev.*, **70**, 748–58 (*Nov.* 1 *and* 15, 1946). A general theory of transport processes in fluids, develope from equations of hydrodynamics and thermodynami generalized for application to multi-component system is presented. The equations for the flow of entropy ar masses of components of the fluid, obtained from t local entropy dissipation, are used to treat the process of viscosity, mobility, diffusion, electrical and therm conductance, thermal transpiration, thermal diffusio and the homogeneous thermoelectric effect. Reciproc relations and other properties of the coefficients associate with each process are obtained, and also inter-relationship between the coefficients of the various processes. Th special conditions for the steady state, the state of pur thermal conduction, and the state of equilibrium ar considered. Investigation of the steady state in therma diffusion indicates that mass flow may persist, contrar to the usual assumption in treatment of experimenta data. A

532.72 : 532.62 *see Abstr.* 770

MECHANICS OF GASES 533

533.15 : 536.2.02 77

Note on a method of measuring diffusion constants JAEGER, J. C. *Trans. Faraday Soc.*, **42**, 615–16 (*Sept.–Oct.*, 1946).

533.15 : 539.132 : 533.7 = 3 *see Abstr.* 777

533.15 : 539.217.5 *see Abstr.* 1004

533.24 774

A small scale hydrogen liquefier. FAIRBANK, H. A. *Rev. Sci. Instrum.*, **17**, 473–7 (*Nov.*, 1946).—A simple Hampson-type liquefier capable of producing about one litre/hr is described. Compressed cylinder hydrogen is used, avoiding the necessity of a compressor or gasometer. Design details of the heat interchangers and other vital parts are included, as well as data on operation and performance. A.

.275 775
Humidity measurements in presence of water-soluble s. WILLIAMS, G. C., AND SCHMITT, R. O. *Industr.* ng *Chem.*, **38**, 967–74 (*Sept.*, 1946).

.51 : 531.788.7 776
Measurement of the ultimate pressures of oil-diffusion ps. BLEARS, J. *Proc. Roy. Soc. A*, **188**, 62–76 c. 31, 1946).—Two ionization gauges were used to sure the pressure in the same vessel. It is shown that vapours of diffusion-pump oils are absorbed in the ges by 2 processes, one transient and one continuous. he steady state, the equilibrium in the electrode space each gauge is dynamic, and the equilibrium pressure ends upon the dimensions of the tube connecting the ge to the vacuum system. From the steady state dings the ultimate pressures are calculated. The imate pressure obtainable by using various oils is died; the values for different oils in the same pump do differ widely. The measurements for some typical s are recorded. L. S. G.

KINETIC THEORY OF GASES 533.7

3.7 : 532.7 *see Abstr.* 772

3.7 : 533.15 : 539.132 = 3 777
A quantum-mechanical diffusion effect. WALDMANN, L. *Naturforsch.*, **1**, 483–4 (*Sept.*, 1946) *In German.*—The ermal diffusion coefficient of a mixture of ortho- and rahydrogen ≠ zero owing to the dependence of the llision parameters on the spin and rotational state of e molecules. Its value is calculated, and its measure- ent by the use of the diffusion thermo-effect [Abstr. 303 (1946)] is discussed. G. J. K.

33.7 : 536.78 778
Tables of second virial and low-pressure Joule–Thomson efficients for intermolecular potentials with exponential epulsion. BUCKINGHAM, R. A., AND CORNER, J. *Proc. oy. Soc. A*, **189**, 118–28 (*March* 27, 1947).—The potentials sed are functions of r, the distance between the centres f the molecules, but not of their relative orientation. he long-range attraction between the molecules is taken be the sum of terms proportional to r^{-6} and r^{-8}, and e short range repulsion is proportional to ε^{-pr}. This otential has four parameters; the position and depth of e minimum of the potential, the relative importance of e r^{-8} term, and the steepness of the exponential repul- ion. The second virial and low-pressure Joule–Thomson oefficients are tabulated for the range of parameters kely to be found in actual molecules, and for tem- eratures from the critical temperature to about 20× his value. The most important of the three quantum orrections is tabulated over the same ranges.

33.75 : 536.71 779
A generalised van der Waals equation of state for real ases. SU GOUQ-JEN, AND CHANG, C. H. *Industr. Engng Chem.*, **38**, 800–2 (*Aug.*, 1946).—A generalized equation, $\pi = \theta/(\beta - \phi) - \alpha/\phi^2$, is proposed in which π and θ are he reduced pressure and reduced temperature, ϕ is the deal reduced volume and is equal to the ratio of the olume, V, to the ideal critical volume, V_{ci}, and α and β re universal constants which are related to the van der Waals' constants a and b and the critical constants by he relationships $\alpha = a/p_c(RT_c/p_c)^2$ and $\beta = b/RT_c \cdot 1/p$. Values for α and β are given for different densities and at higher densities approximate to the theoretical values of 0·422 and 0·125 respectively. The new equation holds for He, Ne, A, H_2, N_2, O_2, air, CO_2, CH_4, $(C_2H_5)_2O$, and some paraffin hydrocarbons almost up to the critical density. W. R. A.

533.75 : 536.71 780
Generalised equation of state for real gases. SU GOUQ-JEN, AND CHANG, C. H. *Industr. Engng Chem.*, **38**, 802–3 (*Aug.*, 1946).—A generalized equation,

$$\pi = \theta/[\phi^2 \cdot (\phi + B)] - A/\phi^2$$

is given which is applicable from low densities to about twice the critical density. $B = B_0\{1 + b/\phi\}$ where B_0, b and A are dimensionless constants independent of the nature of the gas. The equation holds to within 1% below and 2% above the critical density. W. R. A.

533.75 : 536.71 781
Modified law of corresponding states for real gases. SU GOUQ-JEN. *Industr. Engng Chem.*, **38**, 803–6 (*Aug.*, 1946).—A modification of the law of corresponding states [Abstr. 779 (1947)] is discussed and its advantages over the usual expression are reviewed. W. R. A.

VIBRATIONS . ACOUSTICS 534

534.133 : 537.228.1 : 548.0 *see Abstr.* 1036

534.152 : 621.317.39.087.252 782
Aids to stroboscopic measurement. THOMAS, E. L. *Electronic Engng*, **18**, 369–71 (*Dec.*, 1946).—[Abstr. 946 B (1947)].

534.213 ≒ 3 783
On the absorption of waves in turbid [trüben] media. RASMUSSEN, R. E. H. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No.* 11) 15 *pp.* (1941) *In German.*

534.213 : 550.341 *see Abstr.* 1061

534.213.4 : 534.321.9 784
Corrigendum. The propagation of supersonics in capillary tubes. MAY, J. *Proc. Phys. Soc., Lond.*, **59**, 33 (*Jan.*, 1947).—See Abstr. 2959 (1938).

534.222 : 539.132 785
The velocity of sound in hydrogen when rotational degrees of freedom fail to be excited. RHODES, J. E. *Phys. Rev.*, **70**, 932–8 (*Dec.* 1 *and* 15, 1946).—The velocity of sound in parahydrogen, normal hydrogen, and 50-50 para-orthohydrogen mixtures has been observed at several temperatures, and over a range of frequency/pressure ratio from one to 60 Mc/s per atmosphere. Dispersion attributed to failure of the rotational degrees of freedom to follow the temperature associated with the translational degrees of freedom has been observed with all mixtures and at every temperature at which observations were made. Frequency and pressure affect the velocity of sound only as the quotient, frequency/pressure, with small corrections. Experiments indicate that the dispersion occupies a greater range of frequency/pressure than would be expected if the rotational specific heat behaved as a simple relaxation phenomenon. It is shown that a simple relaxation phenomenon is not to be expected, and that the dispersion in parahydrogen can be characterized, approximately, by two relaxation frequency/pressure ratios, for the rotational transition 0–2 and 2–4 respectively. An expression for these ratios, that roughly fits the observations, is derived on the basis of some assumptions about the collision process. A.

534.222.2 : 531.787 786
The experimental study of the blast from bombs and bare charges. GRIME, G., AND SHEARD, H. *Proc. Roy. Soc. A*, **187**, 357–80 (*Nov.* 5, 1946).—An electrical method was used for measuring the pressure in a blast wave, involving the use of piezo-electric gauges with c.r.o's. A detailed description of the apparatus is given. Measurements were made of the blast pressures produced by bare charges up to 2 000 lb in weight, by German bombs and

mines weighing from 50 to 1 000 kg, and by British bombs of all sizes. The measured and calculated velocities of the blast wave are in good agreement, and the observed and calculated rates of decay of maximum excess pressure agree reasonably well. L. S. G.

534.231.3 787

Construction and calculation of a variable acoustic impedance. THORSEN, V. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No* 11) 15 *pp.* (1941).

534.231.3 788

Sensitivity and impedance of electro-acoustic transducers. VIGOUREUX, P. *Proc. Phys. Soc., Lond.*, **59**, 19–30 (*Jan.*, 1947).—The equivalent electric circuits of piezo-electric and magnetostriction electro-acoustic transducers are derived in terms of their mechanical constants, and the output of a transducer placed in a given sound field is calculated in terms of the pressure of the undisturbed field and the radiation resistance of the transducer. It is shown that, with certain reservations, the radiation resistance can itself be estimated from purely electrical measurements of the impedance of the transducer in air and in water over a range of frequencies near resonance, or even at a few selected frequencies. The construction of impedance and admittance diagrams is explained, and it is shown how the frequency of maximum acoustic output of transducers can be obtained from electrical measurements without any acoustic measurements. A.

534.231.3 = 3 789

A new method of measuring acoustic impedances. THORSEN, V. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **20** (*No.* 9) 24 *pp.* (1943) *In German.*

534.232 = 3 790

On the energy radiation from an acoustic resistance. THORSEN, V. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No.* 11) 15 *pp.* (1941) *In German.*

534.232 : 621.395.623.7 = 82 791

Acoustic power output of an electrodynamic horn speaker. TROCEWICH, F. N. *J. Tech. Phys., USSR*, **16** (*No.* 2) 189–98 (1946) *In Russian.*—[Abstr. 497 B (1947)].

534.321.9 : 534.213.4 *see Abstr.* 784

534.37 : 620.178.33 = 5 792

Behaviour of elastic materials used as insulators for mechanical vibrations. RAMA, S. *Alta Frequenza*, **11**, 5–41 (*Jan.*, 1942) *In Italian.*—An elastic wave is propagated in an elastic porous material by two distinct media, the solid body itself and the air within the pores. The propagation can be represented by a system of equations which regard the body as one compact material. The equations are then analogous to those for the propagation of electrical energy along a line, the equivalent quadripole being applicable. A device for measuring the elastic constants of a body is described, in which one face can be loaded with a given weight m and the other set in vibration. Curves giving the ratio between the amplitudes of the exciting and excited vibrations show that the internal friction $\propto m^{\frac{1}{2}}$. Values are given of the damping and rigidity coefficients for various materials and of the velocity of sound through them. A.

534.44 793

Transient analysis of linear systems, using underwater explosion waves. OSBORNE, M. F. M., AND CARTER, J. L. *J. Appl. Phys.*, **17**, 871–3 (*Nov.*, 1946).—The indicial admittance (response to the unit function) of a simple mechanical system, a tourmaline crystal hydrophone, has been determined from its response to an underwater explosion wave. [See Abstr. 1821 B (1943)]. The relative frequency calibration of two hydrophones obtained by Fourier analysis of their responses to the explosion wave is in good agreement with the dire continuous wave comparison. The peak pressure of t explosion wave is also determined from this Four analysis. It is suggested that the explosion wave can used as a tool in acoustical "circuit analysis" in mu the same way that a square wave generator is used electrical circuit analysis.

534.612 : 621.317.72.087.6 = 398 7

Fast intensity recorders. BRÜEL, P. V., AND INGÅRD, *Ingeniøren* (*Elektroteknik*), **55**, E153–8 (*Dec.* 14, 194 *In Danish.*—A description of circuits for registerir sound intensity on a linear db or neper scale, usual through a voltmeter and a compressor circuit, or a automatically adjusted potentiometer. Cascade couplin is discussed, and a valve circuit for a logarithmic-sca voltmeter is given. Diagrams and brief descriptions ar given of the known potentiometer arrangements. J. A. W

534.64 = 5 79

Experimental investigation on the artificial ear BARDUCCI, I. *Ric. Sci. Ricostruz.*, **16**, 1459–62 (*Oct* 1946) *In Italian.*

534.756.2 = 3 79

Mechanical frequency characteristics of the ear ZWISLOCKI, J. *Experientia*, **2** (*No.* 10) 415–17 (1946 *In German.*—After brief reference to the various theorie of hearing from the old resonance theory of Helmholt to the more modern theories and researches of G. von Békésy, the author deals mathematically and experimentally with his own theory based on mechanical frequency analysis of the response of the ear *without* resonance. By means of a model cochlea and basilar membrane with water damping, an experimental study is made of the mode of transmission of vibrations of low, medium, and high frequency. He concludes from these experiments that two factors are important in determining the frequency characteristics of the ear, viz. the flexibility and damping of the basilar membrane. A. B. W.

OPTICS . RADIATION . SPECTRA 535

535.13 : 535.3 *see Abstr.* 806

535.13 : 535.314 *see Abstr.* 808

535.215.2 : 535.34 797

Light absorption and selective photo-effect in adsorbed layers. FRÖHLICH, H., AND SACK, R. A. *Proc. Phys. Soc., Lond.*, **59**, 30–3 (*Jan.*, 1947).—An estimate is often required of the absorption of light by a single layer of atoms (in particular alkali metal atoms) adsorbed on a non-metallic surface. Such an absorption is accompanied in many cases by a selective photo-electric effect at comparatively long wave-lengths. In the present paper the probability is calculated of a light quantum being absorbed by such a layer, and a mechanism suggested for the emission of the photo-electrons. A.

535.23 : 539.11 : 536.63 *see Abstr.* 865

535.23.08 798

Pneumatic heat detector. ZAHL, H. A., AND GOLAY, M. J. E. *Rev. Sci. Instrum.*, **17**, 511–15 (*Nov.*, 1946).—Radiant energy is dissipated in a black absorber located in a gas cell. The heating and expansion of the gas distorts a collodion film located close to a glass window, and shifts a system of interference fringes. A system utilizing 61 cells is described. A.

535.23.08 : 530.162 799

Fluctuations in streams of thermal radiation. LEWIS, W. B. *Proc. Phys. Soc., Lond.*, **59**, 34–40 (*Jan.*, 1947).—An ultimate limit to the sensitivity of a detector of thermal radiation is set by the inherent fluctuations

the stream of radiation. This paper presents the levant quantitative relations to enable these fluctuations be calculated in practical cases. The result is presented the minimum detectable periodic modulation of the ower of a stream for general conditions under which the tector may receive streams of radiation from surrounds at different temperatures, and thermal equilibrium is t necessarily established. The modification necessary hen the spectral frequency-distribution differs from at of full black-body radiation is also presented. imiting factors other than radiation fluctuations are not iscussed. A.

535.23.08 : 621.317.794 800

The reproduction of film type bolometers with rapid esponse. AIKEN, C. B., CARTER, W. H., JR., AND HILLIPS, F. S. *Rev. Sci. Instrum.*, **17**, 377–85 (*Oct.*, 946).—[Abstr. 699 B (1947)].

535.231.4–15 801

The emissivity of hot metals in the infra-red. PRICE, D. J. *Proc. Phys. Soc., Lond.*, **59**, 118–31 (*Jan.*, 1947).—A specially designed vacuum-tight, water-jacketed urnace has been used in the measurement of the missivity of incandescent metals for wavelengths of ·0 to 4·5 μ. Results are given for pure Pt, Fe, Mo, Cu and Ni. A "split cylinder" type of comparison lack-body has been used, and its efficiency has been ompared with a spherical standard. This calibration as suggested a correction to be applied to Ive's standard f visible radiation. It appears that for a wavelength usually in the near infra-red) peculiar to each metal the missivity is constant over a large range of temperature. Such *X-points* have been observed in the case of Fe and Mo, but not with Pt or Cu. A.

535.231.4.096–15 802

The temperature variation of the emissivity of metals in the near infra-red. PRICE, D. J. *Proc. Phys. Soc., Lond.*, **59**, 131–8 (*Jan.*, 1947).—X-points [Abstr. 801 (1947)] are discussed, and it is shown how their existence explains many divergent results obtained for temperature variation of emissivity in the visible region, besides providing a new series of characteristic wavelengths for metals.

535.241 : 535.64 *see Abstr.* 852

535.242 : 535.247.4 = 398 803

Measurement of light and luxmeter calibration. NIELSEN, O. F. *Elektroteknikeren*, **42**, 716–29 (*Dec.* 22, 1946) *In Danish.*—Importance of adequate lighting in factories and offices is discussed, with reference to the Danish Standard (D.S.F. 700). Subjective and objective (photocells) luxmeters are described and calibration and manipulation discussed. Errors are dealt with as well as precautions in handling and transport. J. A. W.

535.247.4 804

A new light balancing circuit for the non-recording densitometer. CARPENTER, R. O'B. *J. Opt. Soc. Amer.*, **36**, 676–8 (*Nov.*, 1946).—A description is given of the application of the electron-multiplier photo-tube and the light-chopping method. The techniques discussed are generally applicable to the measurement of very low light intensities. A.

535.247.4 : 535.242 = 398 *see Abstr.* 803

535.247.4 : 621.383 : 621.317.39 805

Logarithmic photometer. SWEET, M. H. *Electronics*, **19**, 105–9 (*Nov.*, 1946).—Describes a photo-electric photometer, employing a multiplier photocell in a negative feedback circuit, so designed that the indication is proportional to the logarithm of the illumination. The application to densitometry and the measurement of concentration of solutions is described. J. W. T. W.

535.3 : 535.13 806

A note on the foundations of geometrical optics. ARLEY, N. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **22** (*No.* 8) 21 *pp.* (1945).—Maxwell's equations are solved for the case of an arbitrary non-ferromagnetic medium, and lead to well-known conditions for the validity of geometrical optics. The solution also leads to Fresnel's normal equation and to a formulation of the principles of Fermat and Huygens. It is noted that, in the general case, the n in Fermat's principle is the ray-index and not the index of refraction. H. H. HOP.

535.313 : 535.8 = 4 807

Schmidt camera for photography at a finite distance. PAUL, M. *Rev. Opt.* (*Théor. Instrum.*) **23**, 180–4 (*July–Sept.*, 1944) *In French.*—The Seidel aberrations of a Schmidt lens for finite object distance, d, are derived by considering it as a limiting case of a figured 2-mirror system. For finite d the plate remains at the centre of curvature of the mirror, its figuring being proportional to $1/d$. It is shown that for $d = 10$ to $20\times$ the focal length, a plate calculated for $d = \infty$ can be used, the curvature of the mirror and image being suitably changed. H. H. HOP.

535.313 : 535.822 *see Abstr.* 854, 855

535.314 : 535.13 808

The structure of an electromagnetic field in the neighbourhood of a cusp of a caustic. PEARCEY, T. *Phil. Mag.*, **37**, 311–17 (*May*, 1946).—A mathematical and numerical study of the field structure at and near a line focus of a cylindrical wave train. Cylindrical first order aberration is supposed to be present. Possible wavelengths and degrees of aberration may be expressed in terms of

$$I(x, y) = \int_{-\infty}^{\infty} \exp\{i(yt + xt^2 + t^4)\}dt$$

Contours of the modulus and phase of this cusp function are given. L. S. G.

535.317 = 4 809

Paraxial imagery. DURAND, É. *Rev. Opt.* (*Théor. Instrum.*) **23**, 215–21 (*July–Sept.*, 1944) *In French.*—Consideration of paraxial ray-tracing formulae leading to results used in the calculation of aberrations. Expressions are obtained for the paraxial homographic constants of a system. H. H. HOP.

535.317 : 522.22 *see Abstr.* 724

535.317 : 771.351 810

Photographic resolving power. HOWLETT, L. E. *Canad. J. Res. A*, **24**, 15–40 (*July*, 1946).—The nature of photographic resolving power is discussed and attention called to the widespread misconception of it that exists at the present time. An annulus type of target is proposed as more suitable for testing than line targets. A method is given for the selection of the photographic focal plane when the essential requirement of the photographic use is the acquisition of maximum information. Results are presented on a study of a number of well-known types of photographic objectives used for aerial photography. A.

535.317.1 811

The limitations of optical image formation. HERZBERGER, M. *Ann. N.Y. Acad. Sci.*, **48** (*No.* 1) 1–30 (1946).—New variables are introduced into Hamilton's angle characteristic, giving rise to a new function termed the *diacharacteristic*. The rank of a matrix involving the 2nd-order derivatives of the new function gives information about the quality of the image. Different variables are used in the cases of infinite and finite

object distances. The method is applied to a number of special cases. H. H. HOP.

535.317.5 = 4 812

The chromatic and third order aberrations in centred systems. DURAND, É. *Rev. Opt. (Théor. Instrum.)* **24**, 137–50 (*July–Sept.*, 1945) *In French.*—The optical paths along paraxially specified rays are evaluated, and lead to expressions for the Seidel and primary chromatic aberrations. The method applies to any surface of revolution, the particular case of a spherical surface leading to the known results. Numerical examples are given. H. H. HOP.

535.317.9 813

Aspheric corrector plates for magnifiers. HOPKINS, R. E. *J. Opt. Soc. Amer.*, **36**, 604–10 (*Oct.*, 1946).—A detailed account of the design of a reading lens employing a plano-aspheric plate. A fourth order curve is used to correct Seidel aberrations; distortion and astigmatism in particular. Photographs are given illustrating the improvement obtained. H. H. HOP.

535.33.03 : 539.155.2 *see Abstr.* 948

535.33.072–15 814

An infra-red spectroscope with cathode-ray presentation. DALY, E. F., AND SUTHERLAND, G. B. B. M. *Proc. Phys. Soc., Lond.*, **59**, 77–86 (*Jan.*, 1947).—See Abstr. 1568 (1946). A full description and discussion are given. The instrument covers the range 1–16 μ, in steps of about 3 μ. A.

535.33.08 : 535.417 815

Direct determination of wavelengths from Fabry-Perot interferometer patterns. HARRISON, G. R. *J. Opt. Soc. Amer.*, **36**, 644–54 (*Nov.*, 1946).—A new type of measuring and computing engine is described which determines wave numbers directly from spectrograms made by crossing the dispersion of a Fabry–Perot interferometer with that of a concave grating. The fringe pattern is projected on to a screen with magnification proportional to r (order of interference), automatically computed, and brought into line with a set of fiducial curves to read the residual fraction of an order. Results are presented on dials to 7 or 8 figures.

535.33.08 : 545.822 : 535.41 816

Interference in thin parallel surfaced transparent plates as a source of error in spectroquantitative analysis. STERN, J. *J. Opt. Soc. Amer.*, **36**, 654–8 (*Nov.*, 1946).

535.331 = 3 817

Investigations on the spectrum of silver. RASMUSSEN, E. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No.* 5) 32 *pp.* (1940) *In German.*—Twenty-five new lines of Ag I and 75 of Ag II have been found and analysed. Fine structures of lines have been examined interferometrically and the isotope splitting has been observed. A. G. G.

535.337 : 535.343.4–14 *see Abstr.* 827

535.338.332 818

The fine structure of the spectral lines of H_2: measurements with a reflexion echelon. FOSTER, E. W., AND RICHARDSON, O. *Proc. Roy. Soc. A*, **189** (*No.* 1017) 149–74 (1947).—The paper represents the results of experiments and observations made during the last six years with improved apparatus, including a 40-plate reflection echelon. About 250 lines at the red end of the visible spectrum have been examined and their fine structures photographed and measured. These include most of the important lines of the triplet systems $3p^3\Pi \rightarrow 2s^3\Sigma$ and $3d^3\Sigma\Pi\Delta \rightarrow 2p^3\Pi$, as well as important lines of the system $3s^3\Sigma \rightarrow 2p^3\Pi$ and $3Y \rightarrow 2s^3\Sigma$, together with some lines of the triplet system $3p^3\Sigma \rightarrow 2s^3\Sigma$. The singlets are represented by about 20 lines coming from the states $3d^1\Sigma$, $3d^1\Pi_d$, $3s^1\Sigma$, $2s^1\Sigma$, 3^1K, ^1M and ^1N and ending in $2p^1\Sigma$ or belonging to the system $3p^1\Pi \rightarrow 2s^1\Sigma$. There is also a small proportion of unclassified lines. The paper is limited to a descriptive account of the observations and the analysis and tabulation of the data. The analysis will be published separately. A.

535.338.4 819

On the spectra of CS and CSe. HOWELL, H. G. *Proc. Phys. Soc., Lond.*, **59**, 107–11 (*Jan.*, 1947).—The accepted view, that the main CS and CSe band systems are $^1\Pi - ^1\Sigma$ analogous to the Fourth Positive bands, is criticized, and an alternative interpretation is put forward that they are $^3\Pi - ^1\Sigma$ transitions, possibly the counterpart of the CO Cameron bands, with the $^3\Pi$ level possibly perturbed by a $^1\Pi$ level. A.

535.338.4 : 535.371 = 3 820

Natural dissociation spectra of benzene derivatives and their connection with phosphorescence effects. SCHÜLER, H., AND WOELDIKE, A. *Z. Naturforsch.*, **1**, 214–17 (*April*, 1946) *In German.*—Emission spectra of some mono- and di-derivatives of benzene are examined and attributed to spontaneous disruption of excited molecular states, one of the products of the disruption remaining in the excited state. For the substances examined, the phenyl radical is excited in the disruption, its binding electron going to the separated portion. Two types of spectra (blue and green) occur, and their connections are discussed. Similarities between these effects and phosphorescence phenomena in the solid phase are noted, and it is concluded that phosphorescence originates in these cases at disturbed centres within the crystal where a large loosening of the bond between the phenyl radical and the substituted portion of the molecule occurs. C. C.

535.338.4 : 536.52 821

Effective temperatures of molecules in relation to the temperatures of sources. TAWDE, N. R. *Phys. Rev.*, **70**, 432–3 (*Sept.* 1 *and* 15, 1946).—[See Abstr. 1576 (1946)]. Measurements of C arc temperature from vibrational spectra of a number of different molecules, introduced into the arc by various means, showed variations of several thousand °C, thus supporting the suggestion that the temperature measured is the "optimum emission temperature," rather than the actual.

535.338.4 : 539.132 822

On the high pressure bands of carbon and the formation of C_2 molecules. HERZBERG, G. *Phys. Rev.*, **70**, 762–4 (*Nov.* 1 *and* 15, 1946).

535.34 : 535.215.2 *see Abstr.* 797

535.34 : 537.531 *see Abstr.* 881

535.343 823

Determination of continuous absorption coefficients in the spectrum of Na I. RUDKJØBING, M. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No.* 2) 15 *pp.* (1940).—Theoretical calculations of absorption coefficients are made and compared with existing experimental data. A. G. G.

535.343 : 537.531 *see Abstr.* 882, 883

535.343–31 824

On the continuous absorption of the negative hydrogen ion in the ultraviolet. RUDKJØBING, M. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **20** (*No.* 16) 12 *pp.* (1943).—The absorption coefficient of H^- has been calculated at 867, 700 and 506 Å, taking into account transitions to excited states of the neutral atom. A. G. G.

535.343.2 825

Solarization of manganese-bearing glass at higher temperatures. COLLIN, R. L., AND BADGER, A. E. *Phys. Rev.*, **70**, 437–8 (*Sept.* 1 *and* 15, 1946).—The wavelength of the absorption band produced by ultra-violet irradiation was studied in its dependence on the temperature during irradiation or subsequently. The wavelength decreases for higher temperature, but the density of the band is little affected until the lower annealing limit of the glass is reached.

535.343.4 = 4 826

Study in the infra-red spectroscopy of methyl iodide and bromide, normal and deutero-substituted. COURTOY, [illegible]. *Ann. Soc. Sci. Brux.*, **60**, 122–38 (*July* 31, 1946) *In French.*

535.343.4–14 : 535.337 827

Resolution of a rotational line of the OCS molecule and its Stark effect. DAKIN, T. W., GOOD, W. E., AND COLES, [illegible]. K. *Phys. Rev.*, **70**, 560 (*Oct.* 1 *and* 15, 1946).—The absorption line at 0·8107 cm^{-1} was resolved at a pressure of 10^{-1} mm of Hg by waveguide measurements, and presented on an oscilloscope. The line split into two components on application of a steady electric field parallel to the electric vector of the travelling microwave, one component being twice as large and having only half the frequency shift of the other, in agreement with theory. The frequency shift $\propto$ (field strength)^2.

535.343.4–14 : 539.13 828

The ammonia spectrum and line shapes near 1·25-cm wavelength. TOWNES, C. H. *Phys. Rev.*, **70**, 665–71 (*Nov.* 1 *and* 15, 1946).—The "inversion" lines were resolved, their widths being decreased at low pressures to 200 kc/s. Line shapes, intensities, and frequencies were measured and correlated with theory. Calculated intensities and Lorentz-type broadening theory fit experimental results if frequency of collision is 15× greater than that measured by viscosity methods. Splitting due to rotation is in fair agreement with a recalculation of theoretical values. A saturation effect with increase of power absorbed per molecule was observed and an interpretation is made. A.

535.343.4–14 : 539.13 829

The inversion spectrum of ammonia. BLEANEY, B., AND PENROSE, R. P. *Phys. Rev.*, **70**, 775–6 (*Nov.* 1 *and* 15, 1946).—Results of the authors and those of Good [Abstr. 2305, 3124 (1946)] are compared and discussed. W. E. D.

535.343.4–14 : 539.13 830

Microwave spectrum of ammonia. HADLEY, L. N., AND DENNISON, D. M. *Phys. Rev.*, **70**, 780–1 (*Nov.* 1 *and* 15, 1946).—A revision of the theory [Abstr. 742 (1942)] is proposed to explain this spectrum. W. E. D.

535.343.4–14 : 621.317.352.029.64 831

Water spectrum near one-centimeter wavelength. TOWNES, C. H., AND MERRITT, F. R. *Phys. Rev.*, **70**, 558–9 (*Oct.* 1 *and* 15, 1946).—Absorption lines of H_2O and HDO vapour were measured at pressures near 0·1 mm Hg, where their width was only 1·3–1·5 Mc/s [technique, Abstr. 828 (1947)]. The frequency found by Becker and Autler [Abstr. 80 (1947)] for H_2O [attributed by a misprint to HDO here] was confirmed.

535.343.4–31 832

Rotational structure of some electronic bands of chlorine dioxide. COON, J. B. *J. Chem. Phys.*, **14**, 665–86 (*Nov.*, 1946).

535.345.6 833

An inorganic grey solution. THOMSON, L. C. *Trans. Faraday Soc.*, **42**, 663–5 (*Nov.*, 1946).

535.345.6 834

Method for making filters transmitting the near ultra-violet and absorbing visual light. SMITH, B. *Science*, **104**, 490–1 (*Nov.* 22, 1946).—The preparation of a combination of methylene blue, fuchsin and phosphine is described.

535.347 : 535.547 : 548.0 = 4 835

Optical properties of methylene blue crystals. DEMON, L. *Ann. Phys., Paris*, **1**, 101–41 (*March–April*, 1946) *In French.*—It is proposed to utilize the dichroic properties of methylene blue crystals and their properties of orientation to obtain artificially homogeneous dichroic films which will polarize certain visible radiations. Crystals of methylene blue orient themselves in thin coatings. Orientation also results from spreading an aqueous solution on a hot surface. The nature of union of methylene blue crystals and the relations which exist between the parameters of its crystals and those of mica and gypsum have been established. For union, the "carrying" and "carried" crystals should have the same structure and the same symmetry, and, in addition, both crystals should possess ions of the same polarity. W. R. A.

535.36 : 551.463 *see Abstr.* 1065

535.37 836

Luminescence of $(Zn, Be)_2SiO_4$: Mn and other manganese-activated phosphors. SCHULMAN, J. H. *J. Appl. Phys.*, **17**, 902–8 (*Nov.*, 1946).—Spectral energy distribution and luminous efficiency measurements are reported. Quantum efficiencies under 2 537 Å excitation are calculated from this data. The introduction of Be into α-willemite causes a decrease of the "green" luminescence band of this phosphor and the growth of a new emission band with a peak in the neighbourhood of 6 100 Å, the high quantum efficiency being preserved. The general role of Mn as an activator is considered, and the resulting picture used to explain the effect of Be and other substituents for Zn^{+2} or Si^{+4} on the spectral properties and on the luminescence decay of Mn-activated materials. A.

535.37 : 621 837

The industrial applications of luminescence. SOMMER, W. *Electronic Engng*, **18**, 361–8 (*Dec.*, 1946).—A review of some of the properties of inorganic and organic phosphors, with references to Hg discharge tubes, colour filters and photo-electric cells. Methods are described for using luminescence to detect Hg vapour, to detect cracks in materials, and for other applications. S. T. H.

535.371 838

The fluorescence of pure magnesium tungstate. HILL, C. G. A. *Trans. Faraday Soc.*, **42**, 685–9 (*Nov.*, 1946).—The maximum fluorescence efficiency is given by the composition $MgWO_4$, and fluorescence is associated with a particular monoclinic crystal structure. The maximum fluorescence can only be obtained if the tungstate is prepared at a low temperature (*c.* 300°C) before firing at 700°–1 100°C. Three non-fluorescent forms of magnesium tungstate have been found, formed on heating at 300°C, 600°C and 1250°C respectively. The high temperature form was reconverted into monoclinic fluorescent material on heating at 950°C, but no other reverse transitions could be effected. There is no evidence for the formation of a compound corresponding to $2MgO \cdot WO_3$ at high temperatures. It is concluded that the seat of the fluorescence is the particular tungsten–oxygen unit found in the monoclinic form. A.

535.371 : 535.338.4 *see Abstr.* 820

535.371 : 621.327.43 839

Causes of early loss of light output of fluorescent lamps. MEISTER, G., AND NAGY, R. *J. Opt. Soc. Amer.*, **36**, 696–701 (*Dec.*, 1946).—The photo-decomposition of Zn

silicate, ZnBe silicate, Ca tungstate, Mg tungstate, and CaCe phosphate phosphors was studied in vacuum, air, and inert gases. The loss of light output has been shown to be caused by the photolysis of the commercial phosphors, which is in contrast to the general theory in which the loss has been attributed to a film formation on the fluorescent particles. The photolysis of the silicate and tungstate phosphors is mainly caused by radiations less than 2 000 Å. The CaCe phosphate is most sensitive to these radiations. The photochemically active centre in the silicate phosphors appears to be the Mn atom. The W and Ce atoms may be involved in the tungstate and phosphate phosphors, respectively. A.

535.372 840

The luminescent spectra of zinc sulphide and zinc cadmium sulphide phosphors. ROTHSCHILD, S. *Trans. Faraday Soc.*, **42**, 635–42 (*Sept.–Oct.*, 1946).

535.376 841

The light output of zinc sulphide on irradiation with alpha rays. KLASENS, H. A. *Trans. Faraday Soc.*, **42**, 666–8 (*Nov.*, 1946).—A critical review of the literature dealing with the light output of ZnS excited with α-rays shows values of the order of 10–15%, which are the same order of magnitude as those found on irradiation with cathode rays in accordance with the theories of Thomson, Bethe and others. A.

535.39 842

German reflection reducing coatings for glass. TANNER, H. A., AND LOCKHART, L. B., JR. *J. Opt. Soc. Amer.*, **36**, 701–6 (*Dec.*, 1946).

535.39 : 535.5 = 4 *see Abstr.* 850

535.39 : 537.311.1 : 539.23 = 4 *see Abstr.* 1005

535.39.08 = 4 843

Graphical method for the determination of transmission factors of compound plates. PERROT, M. *Rev. Opt. (Théor. Instrum.)* **23**, 185–92 (*July–Sept.*, 1944) *In French.*—Continuing earlier work [Abstr. 1041 (1946)], a similar study is now made in connection with the transmission of light through thin metallic layers deposited on slightly prismatic transparent supports. As in the earlier case, a simple relation is found which allows of the rapid and precise construction of curves giving the transmission factors as a function of the optical constants and the thickness of the layer, also the variation of the transmission factor with changes in these variables. A. H.

535.391.2 = 4 844

Errata. Specular reflection. ARZELIES, H. *Ann. Phys., Paris*, **1**, 359 (*May–June*, 1946) *In French.*—See Abstr. 2573 (1946).

535.41 : 545.822 : 535.33.08 *see Abstr.* 816

535.412 = 4 845

Almost hyperbolic interference fringes. AUBERTIN, A. *Rev. Opt. (Théor. Instrum.)* **24**, 201–14 (*Oct.–Dec.*, 1945) *In French.*—The source used consists of a circular diaphragm of 12 mm radius, illuminated with monochromatic light and placed in the focal plane of a converging lens of 184 mm focus. The emergent light falls on a prism, is refracted to strike the base, and divides into a reflected and a refracted ray; the latter is reflected back into the prism by a plane mirror near the base but not quite parallel to it. The two rays leave the prism and, by means of an inverting prism suitably placed, each ray is reflected back along the path of the other. Calculations of the path difference for rays of different angles of incidence show that, neglecting squares of small quantities, the shape of the fringes formed in the focal plane of the lens will be rectangular hyperbolas, subject to certain experimental conditions. Photographs of the fringes found experimentally confirm the theory. The sharpness of the fringes is not very greatly affected by using light containing all wavelengths between 5 000 Å and 5 500 Å, which is again in accordance with the theory. N. C.

535.417 : 535.33.08 *see Abstr.* 815

535.417 : 539.23 846

Thickness measurements of thin films. PLESSNER, K. W. *Nature, Lond.*, **158**, 915 (*Dec.* 21, 1946).—See Abstr. 308 (1947).

535.417 : 539.23 847

Interferometric determination of apparent thickness of coatings. DONALDSON, W. K., AND KHAMSAVI, A. *Nature, Lond.*, **159**, 228–9 (*Feb.* 15, 1947).—See Abstr. 846 (1947).

535.42 848

Theory of diffraction. PIDDUCK, F. B. *Phil. Mag.*, **37**, 280–7 (*April*, 1946).—A plane electric wave falls upon an infinite dielectric sheet. Expressions are given for the reflected and transmitted intensities and for the field in the sheet. The field is interpreted in terms of electric moment. Diffraction by a small dielectric disc is considered, the total electric intensity at any point being calculated. Three cases are taken: (1) highly conducting disc, (2) absorbing disc, (3) transparent disc. L. S. G.

535.42 : 537.531 *see Abstr.* 884

535.421 = 3 849

Babinet's principle in optics. MEIXNER, J. *Z. Naturforsch.*, **1**, 496–8 (*Sept.*, 1946) *In German.*—It is shown that Babinet's principle can be obtained from rigorous solutions of the electromagnetic diffraction problem in the case when the complementary screens are plane perfect conductors. Following Debye, the field *E*, *H* is replaced by two scalar potential functions. The incident wave is assumed to be plane. H. H. HOP.

535.5 : 535.39 = 4 850

Elliptical reflection (normal and oblique), optical study of thin layers. II. DE MALLEMANN, R., AND SUHNER, F. *Rev. Opt. (Théor. Instrum.)* **23**, 193–214 (*July–Sept.*, 1944) *In French.*—Continuing earlier work [Abstr. 2853 (1946)] on the polarization of the light reflected from complex layers, a study is made of the phenomena encountered when Iceland spar is used as a base with various thin films over the surface. The results indicate that the polished crystal has a homogeneous, isotropic surface layer of the order of 50 Å thick. Details of the experimental technique and of the possible applications are to follow. A. H.

535.547 : 548.0 : 535.347 = 4 *see Abstr.* 835

535.55 : 539.37 *see Abstr.* 1009

535.64 = 3 851

Grassmann's laws of colour mixtures. BOUMA, P. J. *Physica, 's Grav.*, **12**, 545–52 (*Nov.*, 1946) *In German.*

535.64 : 535.241 852

Analytic expressions in photometry and colorimetry. MOON, P., AND SPENCER, D. E. *J. Math. Phys.*, **25**, 111–90 (*May*, 1946).—Equations and tables are presented for the practical application of analytic methods to photometry and colorimetry. A new method is used, in that tables of trichromatic weighting factors are replaced by weighting functions. The use of gamma functions permits all the necessary integrations to be performed simply. The new method and the standard C.I.E. method are supplementary. L. S. G.

535.8 : 535.313 = 4 *see Abstr.* 807

535.822 853

Phase microscopy. BENNETT, A. H., JUPNIK, H.,

OSTERBERG, H., AND RICHARDS, O. W. *Trans. Amer. Micr. Soc.*, **65**, 99–131 (*April*, 1946).—Describes a phase contrast microscope in which an annular stop is placed at the back focal plane of the condenser, Köhler illumination being used. A set of interchangeable diffraction plates can be used in turn by means of a turret, each plate having different phase and amplitude factors. A notation is employed to characterize a given plate. The general theory of image formation is formulated, and the special cases of sinusoidal amplitude and phase gratings are solved. It is claimed that no reduction in resolving power takes place. A number of applications are described, and illustrated by photomicrographs.

H. H. HOP.

535.822 : 535.313 854

Reflecting microscopes. BURCH, C. R. *Proc. Phys. Soc., Lond.*, **59**, 41–6 (*Jan.*, 1947).—The history of reflecting microscopes is reviewed, and the leading Schwarzschild design formulae quoted. Two reflecting objectives are described, and photomicrographs taken with one of these are reproduced. A.

535.822 : 535.313 855

Semi-aplanat reflecting microscopes. BURCH, C. R. *Proc. Phys. Soc., Lond.*, **59**, 47–9 (*Jan.*, 1947).—Numerical values are derived for the offence against the sine condition of reflecting micro-objectives composed of one aspheric concave mirror and one spherical convex mirror. Numerical apertures up to 0·65 are found practicable. A.

535.832 856

Report on survey of optical aids for subnormal vision. ELLERBROCK, V. J. *J. Opt. Soc. Amer.*, **36**, 679–95 (*Dec.*, 1946).

535.87/.88 = 4 857

Theoretical characteristics of a parabolic projector with cylindrical source. FÉVROT, C. *Rev. Opt. (Théor. Instrum.)* **24**, 93–111 (*April–June*, 1945) *In French.*—A study of the intensity distribution given by a parabolic mirror using a small cylindrical source. The problem cannot be solved algebraically and several simplifying assumptions are made to permit of a graphical solution. Various cases are considered and the distribution given in each case. A. H.

HEAT 536

536.1 858

On the concept of heat. BRØNSTED, J. N. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **19** (*No.* 8) 79 *pp.* (1941).—The paper attempts a consolidation and, in some directions, an extension of the author's [Abstr. 2183 (1940)] views on the nature of heat. The concluding section contains a summary of the more essential ideas developed in this and other papers. It is finally concluded that the contention that heat is "motion" or energy of molecular motion, no less than the contention that heat is a fluid, is incompatible with the classical thesis that heat does not possess the character of a single-valued function of state. F. E. H.

536.2 859

A problem in non-steady heat conduction. BROWN, R. L. *Phil. Mag.*, **37**, 318–22 (*May*, 1946).—The problem solved is that of the heat transfer across a refractory wall, to one side of which heat is supplied at a constant rate while the other face is maintained at a constant temperature. An image method is used, and a numerical example is given. L. S. G.

536.2.02 : 533.15 *see Abstr.* 773

536.24 860

The heating or cooling of a solid sphere in a well-stirred fluid. PATERSON, S. *Proc. Phys. Soc., Lond.*, **59**, 50–8 (*Jan.*, 1947).—The solid sphere is of uniform initial temperature, the mass of fluid finite and externally insulated, and temperature continuity is assumed at the surface. Solutions are presented suitable for all values of time, radius and conductivity, and of the ratio of heat capacities of sphere and fluid. Numerical results are given, and certain mathematical relations noted. A.

536.24 861

Application of similarity principles to thermal transport systems. THRING, M. W. *Nature, Lond.*, **159**, 203–4 (*Feb.* 8, 1947).

536.412 : 541.66 862

Note on the empirical relations between chemical constitution and thermal expansion coefficient of organic liquids. STEENSHOLT, G. *Phil. Mag.*, **37**, 357–60 (*May*, 1946).

536.413 : 666 : 532.13 *see Abstr.* 764

536.48 863

A new explanation of liquid helium II. MACLEOD, D. B., AND YEABSLEY, H. J. *Trans. Faraday Soc.*, **42**, 601–15 (*Sept.–Oct.*, 1946).—[See Abstr. 2874 (1946)]. An attempt has been made to explain Helium II as a mixture of the ordinary liquid Helium I and the intermediate form of a fluid, indicated by Van der Waals' equation. On the basis of the volume of the atoms being a function of the total pressure within a fluid, this intermediate form has been shown to be mathematically possible below a certain temperature. The composition of Helium II at various temperatures down to 1·2° K has been worked out approximately. The anomalous specific heat has been explained and calculated and values for the latent heat obtained. A.

536.48 : 536.631 : 538.22 *see Abstr.* 920

536.512 : 551.482.2.018.4 = 397 *see Abstr.* 1066

536.52 : 535.338.4 *see Abstr.* 821

536.531 864

Distant reading electrical air temperature thermometer for use on aircraft. BREWER, A. W. *J. Sci. Instrum.*, **24**, 47–50 (*Feb.*, 1947).

536.63 : 535.23 : 539.11 865

The superficial density of the energy of natural vibrations. BRAGER, A., AND SCHUCHOWITZKY, A. *J. Chem. Phys.*, **14**, 569–70 (*Sept.*, 1946).—Some correction terms are absent in the usual derivations of this energy for a given body, where the boundary conditions are ignored and summations are replaced by integrals. By calculating these terms for an electron gas, the reasonable expression 56 400 $(\gamma/A)^{4/3}$ dyne/cm is obtained for the surface tension of a metal of atomic weight A and density γ. It varies correctly, and has the right order of magnitude. For a solid body the Debye formula for the specific heat is amended by a term proportional to T^2 and the surface area, which suggests that the area of dispersed bodies could be found by specific heat measurements at low temperatures. The surface tension of black-body radiation is also mentioned. G. J. K.

536.631 : 536.48 : 538.22 *see Abstr.* 920

536.654 : 539.133 : 541.57 866

The thermochemistry of carbon: valence states, heat of sublimation and energies of linkage. LONG, L. H., AND NORRISH, R. G. W. *Proc. Roy. Soc. A*, **187**, 337–57 (*Nov.* 5, 1946).—The divergent values given for the heat of sublimation and the strengths of certain chemical

bonds involving C are critically reviewed. A study of the energies of removal of a H atom from the methane and ethane molecules, and the energies of reorganization of the resulting radicals, lead to a value of 190 ± 10 kcal for the heat of sublimation into free atoms in the ^5S state. There is no sound evidence for maintaining the value 170 for the latent heat of sublimation of C into monoatomic vapour in the ground state, and the value of 125 kcal/g-atom is certainly of the right order. L. S. G.

THERMODYNAMICS 536.7

536.7 867

Thermodynamic equilibria of higher order. OLDENBURGER, R. *Phys. Rev.*, **70**, 433–4 (*Sept.* 1 *and* 15, 1946). —[See Abstr. 2587 (1946)].

536.7 : 539.133 868

Some thermodynamical properties of gaseous sulphur dichloride. MCDOWELL, C. A., AND MOELWYN-HUGHES, E. A. *Proc. Roy. Soc. A*, **187**, 398–402 (*Nov.* 5, 1946).—The fundamental vibration frequencies of SCl_2 are calculated from the geometry and dimensions of the molecule. They are used together with known molecular data to calculate the Helmholtz free energy, Gibbs' function, the entropy, the internal energy, heat content and molar heat capacity. L. S. G.

536.71 : 533.75 *see Abstr.* 779, 780, 781

536.78 : 533.7 *see Abstr.* 778

536.782 869

Maximum inversion temperatures of helium, hydrogen, and neon. JOFFE, J. *Phys. Rev.*, **70**, 766–7 (*Nov.* 1 *and* 15, 1946).—It is pointed out that the pseudo-critical values for temperature and pressure should be used in calculating the inversion temperature of He, giving 62·7°K instead of the 23·6°K as estimated by Roebuck and Osterberg [Abstr. 1561 (1933)]. W. E. D.

ELECTRICITY 537

537.122 : 538.3 : 530.14 *see Abstr.* 747

537.122 : 538.312 870

The motional mass of the electron. BODDIE, C. A. *Elect. Engng, N.Y.*, **66**, 45–60 (*Jan.*, 1947).—The author claims to offer a new approach to the study of the interaction of a moving electron and an electric field: in this theory the mass of an electron is constant and independent of velocity, and its kinetic energy has a limiting value of 255 keV, no matter how high the accelerating potential. L. P.

537.123 : 530.14 *see Abstr.* 745

537.123 : 539.18 : 537.531.8 *see Abstr.* 888

537.123 : 537.591 *see Abstr.* 901, 902

537.123 : 537.591.1 : 539.18 = 4 *see Abstr.* 992

537.123 : 537.591.3 : 539.18 *see Abstr.* 993

537.123 : 539.18 *see Abstr.* 989, 990, 991

537.123 : 539.18 : 537.531.8 *see Abstr.* 888

537.123 : 539.18 : 539.172 *see Abstr.* 985

537.226.31 : 666.11 : 621.3.011.5 871

Dielectric properties of glasses at ultra-high frequencies and their relation to composition. NAVIAS, L., AND GREEN, R. L. *J. Amer. Ceram. Soc.*, **29**, 267–76 (*Oct.*, 1946).—[Abstr. 873 B (1947)].

537.228.1 : 534.133 : 548.0 *see Abstr.* 1036

537.228.1 : 549.514.51 : 548.24 = 393 *see Abstr.* 1042

ELECTRIC CURRENTS 537.3

537.311.1 : 535.39 : 539.23 = 4 *see Abstr.* 1005

537.311.33 : 538.632 = 3 872

On the mechanism of the electrical conductivity in silicon carbide. BUSCH, G., AND LABHART, H. *Helv. Phys. Acta*, **19** (*Nos.* 6–7) 463–92 (1946) *In German.*—Determinations of the Hall constant of SiC between 100 and 1 100°K show that green crystals are excess, and black crystals deficit semi-conductors. In order to eliminate the Ettinghausen effect and to achieve high sensitivity, an alternating current was passed through the specimen in the magnetic field (16 000 Gauss) and the Hall e.m.f. measured by means of a normal amplifier. At low temperatures, where the internal resistance of the Hall e.m.f. is very large, an electrometer method was employed. In order to explain the variation of the Hall constant with temperature, it is necessary to assume that conduction is due to the motion of electrons (or deficit electrons) in two discrete energy bands. Theoretical calculations on this basis are in agreement with experimental results, if allowance is made for the initial degeneracy of the electron gas at higher temperatures. H. K. H.

537.311.35 873

Conductivity of metal-amine solutions. WEISSMAN, S. I. *Phys. Rev.*, **70**, 571–2 (*Oct.* 1 *and* 15, 1946).—Phenomena of great reduction of resistance on freezing [see Abstr. 1894 (1946)] were observed with methylamine + several % of ammonia. On melting, two liquid phases separated. The mechanism of the phenomenon is discussed in the light of Ogg's suggestion [Abstr. 2602 (1946)].

537.312.5 874

The photoelectric mechanism of selenium barrier layer elements. SANDSTRÖM, A. E. *Phil. Mag.*, **37**, 347–56 (*May*, 1946).—Mott's theory of the electromotive force [Abstr. 3058 (1939)] is applied to the selenium element. Illumination causes an increase in the blocking-layer capacitance and a decrease of the blocking-layer resistance. Earlier work on the explanation of this [Sandström, *Ark. Mat. Astr. Fys.*, **31 A** (*No.* 2) (1944)] is now further elaborated in the light of Mott's theory, and measurements on 3 selenium photo-elements agree well with the theory. An explanation is given of the fact that conducting bridges form spontaneously over the blocking layer during storage in darkness. L. S. G.

537.312.5 = 3 875

Theory of the barrier-layer photo-electric effect. LEHOVEC, K. *Z. Naturforsch.*, **1**, 258–63 (*May*, 1946) *In German.*—A theory is developed for a metal/impurity semi-conductor boundary assuming that the concentration of electrons and holes in the semi-conductor is fixed by the work function at the boundary, and that absorption of light releases pairs of electrons and holes in the basic lattice. Equations are obtained relating photo-electric current and voltage, intensity of illumination, light frequency, and the properties of semi-conductor and electrodes. Conditions for the occurrence of considerable barrier-layer photo-electric effects are discussed. C. C.

537.312.5 : 621.383.4 876

A new bridge photo-cell employing a photo-conductive effect in silicon. Some properties of high purity silicon. TEAL, G. K., FISHER, J. R., AND TREPTOW, A. W. *J. Appl. Phys.*, **17**, 879–85 (*Nov.*, 1946).—A pure photo-conductive effect was found in pyrolytically deposited and vaporized Si films. An apparatus is described for

making bridge type photo-cells by reaction of Si tetrachloride and hydrogen gases at ceramic or quartz surfaces at high temperatures. The maximum photo-sensitivity occurs at 8 400–8 600 Å with considerable response in the visible region of the spectrum. The sensitivity of the cell appears about equivalent to that of the Se bridge and its stability and speed of response are far better. For pyrolytic films on porcelain there are three distinct regions in the conductivity as a function of temperature. The data lead to the conclusion that the same electron bands are concerned in the photo-electric, optical, and thermal processes, and that the low values of specific conductances found ($1{\cdot}8\times10^{-5}$ ohm^{-1} cm^{-1}) are caused by the high purity of the Si rather than by its polycrystalline structure. A.

537.312.62 877

Penetration of magnetic field into superconducting mercury. DÉSIRANT, M., AND SHOENBERG, D. *Nature, Lond.*, **159**, 201–2 (*Feb.* 8, 1947).—The diamagnetic susceptibility χ of Hg in fine glass capillaries (radius r) was measured, and from its departure from χ_0 ($\frac{1}{4}\pi$ for field parallel to the cylinder axis, or $\frac{1}{2}\pi$ for transverse field) the penetration depth λ was determined, by means of the equation $\chi/\chi_0 = 1 - 2\lambda/r$. The value of λ at 2·1°K was estimated at $\sim10^{-5}$ cm, and its variation with temperature is shown graphically. Relations with previous results [Abstr. 1630 (1940), 4134 (1939), 3155 (1946)] are discussed.

537.312.62 878

Persistent currents in frozen metal-ammonia solutions. HODGINS, J. W. *Phys. Rev.*, **70**, 568 (*Oct.* 1 *and* 15, 1946).—Experiments resulting in the detection of persistent currents [see Abstr. 1894, 3156 (1946)] on 4 occasions out of 115 attempts, are described in detail.

537.312.8/.9 : 538.114 *see Abstr.* 917

ELECTRICAL DISCHARGES AND RADIATIONS
537.5

537.525 : 542.921.9 = 4 *see Abstr.* 1032

537.525.72 879

Electrodeless discharges and some allied problems. BABAT, G. I. *J. Instn Elect. Engrs, Pt III*, **94**, 27–37 (*Jan.*, 1947).—Electrodeless discharges in h.f. electromagnetic fields were investigated in conditions where the ratio of linear dimension l of the discharge space to the electromagnetic wavelength λ in air was $10^{-3} < l/\lambda < 10^{-1}$, at frequencies between 10^6 and 10^8 c/s. The power introduced into the discharge space varied from fractions of watts to 100 kW, and the electric field strength was varied between tens and hundreds of volts per cm. There are two different types of discharge: "E-discharges," in which the elementary conductance currents are continued by dielectric currents, and "H-discharges," with elementary conductance currents in the form of closed curves. When l/λ is $<10^{-1}$, the electrodeless discharges in air at atmospheric pressure may exist at distances of the order of centimetres from the current-carrying electrodes. Further development of the u.h.f. technique leads to constructions of electromagnetic radiators in which the dimension $l > \lambda$. With such radiators it is possible to have high concentration of electromagnetic energy at distances x up to l^2/λ which may be some metres or perhaps kilometres from the electromagnetic radiator. When $l \gg \lambda$ and $l^2 \gg x\lambda$ it is possible for a natural breakdown to occur in an electromagnetic ray. A.

537.529 : 548.0 *see Abstr.* 1037

537.531 880

The distribution of energy in continuous X-ray spectra corresponding to different forms of high tension, and the influence of filtering. I–II. DE WAARD, R. H. *Proc. K. Ned. Akad. Wet.*, **49** (*No.* 8) 944–54; (*No.* 9) 1011–15 (1946).—I. The expression suggested by Kulenkampff for constant potential conditions is used as the basis for deductions of the energy distribution under a variety of conditions. λ_0, the shortest wavelength present, and λ_m, the wavelength of maximum intensity, are shown to characterize the inhomogeneity of the beam. The effect of filtration is discussed. The distribution of spectral energy is considered for: (*a*) single-phase, (*b*) 3-phase a.c., (*c*) the Villard circuit. II. The formulae are applied numerically to special cases of 50 and 70 kV peak single-phase a.c.; the deductions fit Bouwers' experimental curves if allowance is made for an intrinsic tube filtration. This arises in part from absorption in the tube window and in a thin W layer on it, and in part from internal absorption in the anode. H. M.

537.531 : 535.34 881

A method for controlling scattered radiation in obtaining X-ray absorption data by photographic means. SEEMANN, H. E., AND MACGILLIVRAY, L. L. *Rev. Sci. Instrum.*, **17**, 539–42 (*Dec.*, 1946).—Errors can be materially reduced by: (1) irradiating a minimum amount of matter, (2) placing the absorbing material some distance from the film, and (3) keeping the different filter elements separated by Pb partitions so that scattering cannot spread indefinitely. These conditions have been met by the use of a Pb chamber made up of several parallel longitudinal compartments. Filters differing in thickness are placed over holes in the end where the X-rays enter, and recording films are located at the exit end. This system has the further advantage that all filters are exposed simultaneously, thus promoting accuracy in relative absorption measurements, particularly when short exposure times only are possible. 97% of the scattering is eliminated. A.

537.531 : 535.343 882

Secondary structure in the *K* absorption limit of germanium tetrachloride. SHAW, C. H. *Phys. Rev.*, **70**, 643–5 (*Nov.* 1 *and* 15, 1946).—An experimental determination was made under conditions of high resolving power with the two-crystal spectrometer. Both position and magnitude of the structure were obtained for comparison with theory [Abstr. 883 (1947)]. A.

537.531 : 535.343 883

The theory of the fine structure of X-ray absorption limits in polyatomic molecules. CORSON, E. M. *Phys. Rev.*, **70**, 645–52 (*Nov.* 1 *and* 15, 1946).—The theory is developed in a form which takes molecular configuration into account, and it is found that the Petersen formula represents a limiting case. The fine structure of the *K*-absorption limit is calculated for several molecular models, in particular that of Ge in $GeCl_4$, for which comparison is made with the previous calculation of Hartree, Kronig, and Petersen [Abstr. 3778 (1938)] and the experimental results of Shaw [Abstr. 882 (1947)]. A.

537.531 : 535.42 884

An experimental study of the quantum nature of X-rays. GIVENS, M. P. *Phil. Mag.*, **37**, 335–46 (*May*, 1946).—The X-rays symmetrically diffracted by the (130) and ($1\bar{3}0$) planes of NaCl are studied. Two G.-M. counters were used as detectors in a coincidence circuit. 2×10^7 quanta were counted by each counter but only 12×10^3 apparent coincidences were observed. This small number is interpreted as indicating absence of coherence between 2 diffracted X-ray beams. L. S. G.

537.531 : 548.73 *see Abstr.* 1045

537.531 : 616.073.75 885

The intensity of scattered X-radiation in medical radiography. I. DE WAARD, R. H. *Proc. K. Ned. Akad. Wet.*, **49** (*No.* 8) 955–66 (1946).—Calculations are made of the intensity of scattered radiation on the emergent face of water sheets irradiated by parallel X-ray beams of circular cross-section. The classical expression for scattering deduced by J. J. Thomson is used as the basis of calculation, and is considered adequate over the wavelength range used in medical radiography. For an infinite beam falling perpendicularly on to the water the intensity of the secondary radiation due to an elemental sheet is deduced. The expression includes the exponential integral $\int_x^\infty e^{-z}/z\,dz$. It is shown that a satisfactory approximation can be obtained by substituting a function of the form $e^{-a\mu x}$ or the sum of two such functions. This substitution simplifies the evaluation of the scatter from a thick layer of water and enables scattered radiation of all orders to be dealt with. The solution is given for the cases of a thin water sheet ($h < 3$ cm) and a thicker water sheet for infinite incident X-ray beams. Two values of μ (0·20 and 0·30 cm^{-1}) are used. H. M.

537.531 : 616–073.75 886

The intensity of scattered X-radiation in medical radiography. II. DE WAARD, R. H. *Proc. K. Ned. Akad. Wet.*, **49** (*No.* 9) 1016–24 (1946).—The theory of I [Abstr. 885 (1947)] is extended to enable beams of finite cross-section to be dealt with. Numerical calculations show how far the substitution of the simpler functions for the exponential integral is valid. Results are deduced and exhibited graphically for the scatter intensity on the emergent side as a proportion of the direct radiation, for water sheets of different thicknesses irradiated by beams of varying diameters. Two values of μ are used (0·20 and 0·30 cm^{-1}). Quantitative agreement with Wilsey's experimental results (1921) is close, provided the correct value of wavelength is assumed. This value appears to be 0·02–0·05 Å > the wavelength of maximum intensity used by Wilsey. This is interpreted as representing the wavelength increase due to the Compton effect. H. M.

537.531.8 887

Secondary radiation from X-ray filters. II. The design of efficient multimetal filters. MORROW, N. M. *Canad. J. Res. A*, **24**, 46–56 (*July*, 1946).—[See Abstr. 701 (1943)]. An experimental procedure for the design of filters is presented, and applied to a Coolidge type tube operated at 100 kV, for which it is found that 0·043 g/cm^2 of Cu backed by 0·08 g/cm^2 of Al is highly effective. A.

537.531.8 : 539.18 : 537.123 888

Production of heavily ionizing particles by X-rays generated by a 100-MeV betatron. SCHEIN, M., HARTZLER, A. J., AND KLAIBER, G. S. *Phys. Rev.*, **70**, 435–6 (*Sept.* 1 *and* 15, 1946).—Three photographs of cloud-chamber tracks are shown, taken in the presence of a 900-oersted magnetic field. The evidence that these tracks are caused by mesotrons is discussed.

537.533 : 539.181 *see Abstr.* 994

537.533.73 : 548.74 = 4 889

Study of insulating materials by electron diffraction. DEVAUX, J. *Ann. Radioélectricité*, **1**, 324–6 (*April and July*, 1946) *In French.*—Electron diffraction patterns of insulating materials obtained by the usual reflection method are distorted on account of the accumulation of charges by the specimen. These charges may be dissipated by irradiating the specimen with low-speed electrons (0–2·5 kV), and the excellent quality of the patterns then obtained is demonstrated by diffraction photographs of crystalline and powdered quartz. Evidence is quoted in support of the explanation of the discharging effect of low-speed electrons put forward by Brubaker and Fuller. [See Abstr. 2317 (1945)]. H. J. H. S.

537.533.74/.75 890

Influence of intercrystalline forces on β-ray absorption. WINCHESTER, G. *Phys. Rev.*, **70**, 437 (*Sept.* 1 *and* 15, 1946).—[See Abstr. 1652 (1946)].

537.533.8 891

Secondary emission from germanium, boron, and silicon. KOLLER, L. R., AND BURGESS, J. S. *Phys. Rev.*, **70**, 571 (*Oct.* 1 *and* 15, 1946).—Bombarding electron beam voltages from 100 to 1 500 V were used. The maximum secondary emission ratios were: B, 1·2 at 150 V; Ge, 1·2 at 400 V; Si, 1·1 at 250 V.

537.533.9 : 621.385.83 = 82 892

Radiation of relativistic electrons in a magnetic field. POMERANCHUK, I. I. *Bull. Acad. Sci. URSS, Sér. Phys.*, **10** (*No.* 3) 316–18 (1946) *In Russian.*—The radiation grows in proportion to the square of the energy of the electron, and is shown to play a role at speeds attained in the betatron; it can be reduced by keeping the field H low and the frequency of field change high. The effect on electron bunches in circular orbits of accelerators like the "synchrotron" is studied, and the electron groups are shown to follow Poisson's distribution. Under normal conditions of electron concentration, their interaction effects do not affect their radiation in a magnetic field, if the harmonics are not of a low order. A. L.

537.533.92 893

The ionization in air by fast β particles and the influence thereon of the vapour mixture of ethyl-alcohol and water. BEEKMAN, W. J. *Physica, 's Grav.*, **12**, 534–41 (*Nov.*, 1946).—Tracks were photographed in a cloud chamber filled with ethyl alcohol and water vapours (60/40 mixture by volume) and air at 1, ½ or ¼ atmos. Primary and probable (total) ionization/cm was measured by counting clusters and drops, and the ionization in the air and the vapour separated by assuming that in air it varies linearly with the pressure. Measurements were made for values of $H\rho$ between 1 200 and 2 400.

537.542 894

Measurement of high intensities with the Geiger-Mueller counter. MUEHLHAUSE, C. O., AND FRIEDMAN, H. *Rev. Sci. Instrum.*, **17**, 506–10 (*Nov.*, 1946).—With sufficient amplification of the pulses from a G-M counter, it was observed that the deadtime decreased as the counting rate increased. The maximum counting rate of a tube could be advanced to 100 000/sec although its apparent resolving power at low rates ≯ 10 000/sec. Above 10 000/sec the resolving power increased almost in proportion to the counting rate. A.

537.542 895

An improvement on the copper evaporation, Geiger-Müller counter. DE VOS, P. J. G., GÜRGEN, K., AND DU TOIT, S. J. *Rev. Sci. Instrum*, **17**, 516 (*Nov.*, 1946).

537.542 : 539.166.08 896

Design of a proportional counter for gamma-rays. BENSON, B. B. *Rev. Sci. Instrum.*, **17**, 533–6 (*Dec.*, 1946).—The design and details of construction are described, including the circuit diagrams for the pre-amplifier, the main video amplifier, and the stabilized high voltage supply. The counter is operated with pure A, or with A plus a little air, at 50 cm pressure and about

750 V. When used with a coincidence circuit, employing blocking oscillators for sharpening the pulses, a resolving time of 4×10^{-8} sec is obtained. A.

37.562 : 621.385 897

The sensitivity of a space-charge detector to the presence of positive ions of helium with small kinetic energies. MILLEST, D. M. *Phil. Mag.*, **37**, 323–34 *May*, 1946).—The energies are in the 25–125 eV range, and the ions augment the space-charge-limited electron current from a hot cathode to a neighbouring anode. The increase is measured as a function of: (1) the potential difference between anode and cathode, (2) the cathode temperature, (3) the kinetic energy of the ions, and (4) the He pressure. The minimum positive-ion current which can be measured with the detector is investigated. L. S. G.

37.563 : 539.13 *see Abstr.* 930

37.564 : 551.510.535 898

The mechanism of ionospheric ionization. II. WOOLLEY, R. v. d. R. *Proc. Roy. Soc. A*, **187**, 403–15 (*Dec.* 13, 1946).—[See Abstr. 366 (1947)]. The contributions to electron densities made by metastable states of atoms and molecules is examined. Observed electron densities may be accounted for without requiring high solar energy in the ultra-violet if the effective recombination coefficient in the F_2 region is 10^{-11}. These assumptions are made: the F_2 and E regions are formed by the ionization of atomic and molecular O respectively; the electrons forming the F_1 region are provided by metastable N_2 or by NO. L. S. G.

537.568 : 551.510.535 899

The basic reactions in the upper atmosphere. I. BATES, D. R., AND MASSEY, H. S. W. *Proc. Roy. Soc. A*, **187**, 261–96 (*Nov.* 5, 1946).—Properties of the upper atmosphere, especially the ionosphere and night-sky emission, are discussed. Various means of producing atmospheric ionization are studied, and the collision processes are classified into: (1) recombination of oppositely charged particles, (2) attachment of electrons to neutral particles, (3) detachment of electrons from negative ions, (4) electron transfer between neutral particles and positive or negative ions. Each of these is critically examined. The theory of the equilibrium of the layers is built up, and emphasis is given to the outstanding problem of explaining the rate of disappearance of electrons. Various possibilities for the origin of the night-sky light are also examined. For earlier work see Abstr. 130 (1938), 1971 (1943). L. S. G.

537.58 = 82 900

Emission of complex surfaces. LUKIRSKIJ, P. I. *Bull. Acad. Sci. URSS, Sér. Phys.*, **10** (*No.* 3) 309–15 (1946) *In Russian.*—After surveying modern emission theories, complex emitters, mainly Sb–Cs cathodes, are discussed. It is considered that such a cathode is a semi-conductor with an outer potential barrier much reduced by a monatomic layer of Cs. The apparent contradiction due to constancy of emission with varying temperature is explained to be due to the "perforated" nature of this semi-conductor, without electrons in the conductive zone, so that auto-emission can take place in the saturated zone only, which is constant with temperature. A. L.

COSMIC RAYS 537.591

537.591 : 537.123 901

The average specific ionization of cosmic-ray mesons in hydrogen, helium, and argon. SKOBEL'TSYN, D. V. *Phys. Rev.*, **70**, 619–24 (*Nov.* 1 *and* 15, 1946).—Counter-controlled, cloud-chamber photographs have been taken of cosmic-ray meson tracks in H, He, and A gases. The chamber was operated in such a way that the average probable ionization could be determined from the counted number of drops that condensed on positive ions. Clusters of droplets that required energy transfers up to 25× (average energy spent per ion pair) were included. The observed results were corrected for the ionization in the alcohol and water vapours used in the chamber. The ionization correction amounted to less than 25% for H and He gases and less than 1% for A gas. The average probable ionization per cm at N.T.P. in H gas was 8·00, in He gas 9·67, and in A gas 65·5. The probable error was about 7%. The results were used to check with theory. There was very good agreement between theory and experiment for H, A, and air, but in the case of He the discrepancy exceeded the estimated experimental error. A.

537.591 : 537.123 902

The mass of cosmic-ray mesotrons. FRETTER, W. B. *Phys. Rev.*, **70**, 625–32 (*Nov.* 1 *and* 15, 1946).—The range of mesotrons in Pb as a function of their momentum was determined in an experiment in which two simultaneously expanded counter-controlled cloud chambers were used. The upper chamber was in a magnetic field of 5 300 gauss, while the lower, which was vertically in line, contained eight ½ in thick Pb plates. The range of a particle that stopped in one of the plates in the lower chamber, together with the H_ρ as measured in the upper chamber, suffice to determine the mass. Data for 26 particles have been obtained, which indicate that, within the experimental error, the masses of mesotrons as measured in this experiment are all consistent with a unique rest mass of 202 × the rest mass of an electron. Statistical and systematic errors are analyzed. A.

537.591 : 539.16.08 *see Abstr.* 949

537.591.1 : 537.123 : 539.18 = 4 *see Abstr.* 992

537.591.15 903

Showers of penetrating particles at altitude of 22 000 feet. SALA, O., AND WATAGHIN, G. *Phys. Rev.*, **70**, 430 (*Sept.* 1 *and* 15, 1946).—Measurements made on an aeroplane flight with a 4× coincidence arrangement [Abstr. 1882 (1945)] registering only particles with $>10^9$ eV energy show, by comparison with similar measurements at lower altitudes, that the density of these particles decreases very rapidly with depth in the atmosphere (probably exponentially).

537.591.15 904

Investigation of Auger showers by the proportional counter method. LAZAREVA, L. *Phys. Rev.*, **70**, 439–40 (*Sept.* 1 *and* 15, 1946).—Coincidences between 2 trays, each of 6 parallel-connected proportional counters, placed in a horizontal plane at a given separation, were used for the detection of Auger showers, in preference to ionization chambers, because of their insensitivity to heavily-ionizing particles and to fluctuations caused by the edges of showers. The curve of log frequency v. log density is linear and agrees approximately with the observations of Auger [Abstr. 1138 (1939)], but those of Young and of Montgomery [Abstr. 4302 (1939), 4954 (1937)] differ both in absolute value and in slope. The variation in frequency of coincidences when Pb absorbers are placed above the trays is shown. The measurements were made at 3 860 m altitude.

537.591.15 905

Penetrating (atmospheric) showers in cosmic rays. VEKSLER, V., GROSHEV, L., AND LAZAREVA, L. *Phys. Rev.*, **70**, 440–1 (*Sept.* 1 *and* 15, 1946).—The number of

coincidences between counter trays arranged horizontally [Abstr. 904 (1947)] was compared with that when they were arranged one above the other, and was found to be only about ½. The difference, however, could not be ascribed entirely to heavily ionizing particles, as a substantial proportion of the vertical coincidences remained when 12 cm of Pb is interposed, indicating penetrating (probably meson) showers. These showers were produced in the atmosphere, as the apparatus was effectively in the open air, and were about twice as frequent as Auger showers producing >10 particles in each 700 cm² tray, 50 cm apart. The mechanism of production of these showers is discussed.

537.591.15 906

Atmospheric showers and bursts. SKOBELTZYN, D. *Phys. Rev.*, **70**, 441–2 (*Sept.* 1 *and* 15, 1946).—The author discusses the results reported in preceding papers [Abstr. 904, 905 (1947)] in relation to the suggestion that fast electrons generating Auger showers are themselves generated in the atmosphere, and do not enter it from outside.

537.591.15 907

Penetrating cosmic ray bursts. GEORGE, E. P., AND JANOSSY, L. *Phys. Rev.*, **70**, 773 (*Nov.* 1 *and* 15, 1946).—A penetrating component was observed in the bursts, and several possible explanations are put forward. W. E. D.

537.591.15 908

A cloud-chamber investigation of penetrating showers. ROCHESTER, G. D. *Proc. Roy. Soc. A*, **187**, 464–79 (*Dec.* 13, 1946).—The investigation shows that the cloud-chamber data are consistent with Jánossy's counter data [Abstr. 1098 (1942)], and with the view that penetrating showers consist of a small number of penetrating ionizing particles, mainly mesons. The theory of meson production due to Hamilton, Heitler and Peng [Abstr. 2834 (1943)], together with Jánossy's suggestion of the emission of small groups of mesons every few cms of lead, is sufficient to explain the shower production. The spectrum of the penetrating particles is of the same form as the meson spectrum at sea-level. 20% of the penetrating showers are accompanied by what appear to be electron cascades. These showers cannot be due to knock-on electrons, or high-energy electron cascades or to decay of electrons, unless a meson of lifetime $<10^{-10}$ sec is postulated. The showers may be due to electrons or photons produced in processes which are important at very high energies, e.g. $>10^{11}$ eV. L. S. G.

537.591.15 909

The density spectrum of the extensive cosmic-ray showers of the air. COCCONI, G., LOVERDO, A., AND TONGIORGI, V. *Phys. Rev.*, **70**, 841–9 (*Dec.* 1 *and* 15, 1946).—The paper describes measurements performed at 2 200 m above sea level. It is found that the relation of the number of showers to their density can be expressed over a wide range by an exponential law. A.

537.591.15 910

Penetrating particles in air showers. COCCONI, G., LOVERDO, A., AND TONGIORGI, V. *Phys. Rev.*, **70**, 852–4 (*Dec.* 1 *and* 15, 1946).—Experiments at 2 200 m above sea level showed that the extensive cosmic-ray showers in air contain both electrons and mesons. A.

537.591.2 911

The energy spectrum of cascade electrons. TAMM, I., AND BELENKY, S. *Phys. Rev.*, **70**, 660–4 (*Nov.* 1 *and* 15, 1946).—The theoretical investigations on the energy spectrum of shower electrons by Rossi and Klapman [Abstr. 1841 (1942)] and by Bhabha and Chakrabarty [Abstr. 1976 (1943)] are analysed and compared with the theory developed by the authors. A.

537.591.2 91

On the fine structure of zenithal curves of the cosmic radiation. COCCONI, G., AND TONGIORGI, V. *Phys. Rev.* **70**, 850–2 (*Dec.* 1 *and* 15, 1946).—Differential measurements of the absorption in Pb of the mesonic component of cosmic radiation at 2 200 m above sea level, and also measurements of the variation of the mesonic component with zenith angle, do not confirm the existence of a fine structure in the intensity spectrum. The variation with zenith angle is perfectly regular, and roughly follows the $\cos^2\theta$ law. A

537.591.3 913

A comparison of the stopping power of lead and aluminium for cosmic-ray mesotrons. FEIN, E. *Phys. Rev.*, **70**, 567 (*Oct.* 1 *and* 15, 1946).—Experiments with Al and Pb absorbers between sets of coincidence-arranged counters indicated that the relative absorption does not follow the Bethe–Bloch ionization loss theory, that of Al being relatively higher.

537.591.3 914

Transition effects of the soft component of cosmic rays. VERNOV, S. N., AND VAVILOV, O. N. *Phys. Rev.*, **70**, 769–70 (*Nov.* 1 *and* 15, 1946).—The transition curves for air to lead show a very sharp maximum, which is a result of an experimental arrangement whereby the slower electrons are not lost by scattering. Results are in accord with the cascade theory of showers. W. E. D.

537.591.3 : 537.123 : 539.18 *see Abstr.* 993

537.591.5 915

Three unusual cosmic ray increases possibly due to charged particles from the sun. FORBUSH, S. E. *Phys. Rev.*, **70**, 771–2 (*Nov.* 1 *and* 15, 1946).

537.591.5 916

Additional cosmic ray measurements with the V-2 rocket. GOLIAN, S. E., KRAUSE, E. H., AND PERLOW, G. J. *Phys. Rev.*, **70**, 776–7 (*Nov.* 1 *and* 15, 1946).—[See Abstr. 3174 (1946)]. Protection was afforded against the showers previously reported. The total intensity reached a peak at ~70 mm Hg of 3 × the free-space value; in free space the hard component ≃70% of the total.

MAGNETISM 538

538.11 : 530.14 = 3 *see Abstr.* 746

538.114 : 537.312.8/.9 917

Magnetoresistance and domain theory of iron-nickel alloys. BOZORTH, R. M. *Phys. Rev.*, **70**, 923–31 (*Dec.* 1 *and* 15, 1946).—Measurements of change of electrical resistivity with magnetization and with tension are reported for Fe–Ni alloys containing 40 to 100% Ni. When the magnetostriction is negative (81 to 100% Ni), tension (σ) decreases resistivity, and magnetic field (H) increases it. Domain theory predicts the ratio σ/H at which the resistivity is equal to that of the unmagnetized specimen, and the theory is accurately confirmed. Measurements are made in transverse as well as longitudinal magnetic fields, and the difference between the resistances so measured is shown to be independent of the distribution of domains in the unmagnetized state; the erratic results reported in the literature are thus explained and avoided. When magnetostriction is positive, the limiting changes of resistivity with field and tension are sometimes found to be different; this is shown to be caused by the variation of magnetostriction with crystallographic direction. A.

538.114 : 539.215 : 539.23 918

Theory of the structure of ferromagnetic domains in ms and small particles. KITTEL, C. *Phys. Rev.*, **70**, 5–71 (*Dec.* 1 *and* 15, 1946).—The theory is developed r bodies whose smallest dimension is comparable with e thickness of the Weiss domains as found in crystals ordinary size. Calculations of the domain boundary, agnetic, and anisotropy energies of various domain nfigurations are given for thin films, small particles, and ng needles of ferromagnetic material. For sufficiently nall dimensions, the optimum structure consists of a ngle domain magnetized to saturation in one direction, hich implies unusual magnetic characteristics, such as ve in fact been reported. The critical dimensions for ansition from a configuration with domain structure to saturated configuration are estimated at $\sim 3\times10^{-5}$ cm films and $\sim 2\times10^{-6}$ cm in particles or grains. A.

538.122 919

The lines of force through neutral points in a magnetic eld. OWEN, D. *Proc. Phys. Soc., Lond.*, **59**, 14–18 *Jan.*, 1947).—It is shown that, having precisely located neutral point in a magnetic field as the point of inter-ction of two directional loci, it is practicable to draw ne lines of force passing through the point. The theory f the field near a neutral point is treated from a geo-netrical point of view. Examples are shown of fields lotted when a bar magnet is set parallel or at an angle the Earth's horizontal field. A.

538.22 : 536.48 : 536.631 920

The magnetic and caloric behaviour of copper potassium ulphate at temperatures below 1°K. DE KLERK, D. *Commun. K. Onnes Lab., Leiden* (*No.* 270*e*). *Physica*, *'s Grav.*, **12**, 513–32 (*Nov.*, 1946).—[See Abstr. 2914 (1946)]. The salt was cooled down together with chromium alum by the magnetic method, the heat contact between he two salts being obtained with liquid He. In this egion $CuK_2(SO_4)_2 . 6H_2O$ obeys a Curie–Weiss law with $\theta = 0\,052$°K. The specific heat, deduced from earlier measurements, did not obey a $1/T^2$-law, in contrast to heoretical expectations. However, when the magnetic emperature scale of the salt is corrected by using the Curie–Weiss law, a $1/T^2$-law is found with a constant of $1{\cdot}8\times10^{-4}\,R$. This is much bigger than the "spin-only" alue $(1{\cdot}35\times10^{-4}\,R$ [Abstr. 1826 (1937)], but it is in xcellent agreement with the formula for exchange oupling. A.

538.22 : 538.61 = 4 921

On the orientation of some molecules and crystals by he magnetic field. I. Magneto- and electro-optic roperties of nitric oxide. BIZETTE, H. *Ann. Phys.*, *Paris*, **1**, 233–305 (*May–June*, 1946) *In French.*—Polari-meter tubes suitable for the range −80 to +20°C and pecially designed to withstand internal pressure without ppreciable birefringence of the end plates are described. Simpler pyrex tubes suffice for liquid NO down to its reezing point. The NO molecule has an unpaired lectron, and in one quantum state has a magnetic moment, which is absent in the polymer $(NO)_2$. Expressions based on the theory of van Vleck are developed for the temperature variation of the sus-ceptibility, the magnetic rotatory power, and the magnetic birefringence, it being assumed that no polymerization takes place. The susceptibility of liquid NO at −161·4°C was found to be $3{\cdot}54\times10^{-6}$, or about 3% of the theoretical value for NO molecules, so that about 97% of the molecules had polymerized at this temperature. The magnetic birefringence indicated the same value. The Verdet constant at −156°C was found to be $-9{\cdot}98'\times10^{-3}$ for $\lambda = 4\,360$ Å. This value, with some assumptions about the diamagnetic rotatory power of polymerized molecules, indicates about 88% polymerization. At −104°C, 68·5 kg/cm², the Verdet constant was $-3{\cdot}68'\times10^{-2}$, indicating $\gtrsim 32\%$ polymerization. The decrease in polymerization is accompanied by the disappearance of the blue colour of the liquid. The Kerr constant of NO gas is $7{\cdot}5\times10^{-12}$ at 20°C, 50 kg/cm², $\lambda = 5\,460$; of NO liquid, $1{\cdot}14\times10^{-7}$ at −161·4°C, $\lambda = 4\,360$; of CO, $2{\cdot}27\times10^{-12}$ at 24°C, atmospheric pressure, $\lambda = 5\,460$; of N_2, $2{\cdot}76\times10^{-12}$ under the same conditions; and of liquid CO, $1{\cdot}11\times10^{-8}$ at 77°K, $\lambda = 5\,460$. The results for NO are compared with earlier measurements on N_2 and O_2. A. J. C. W.

538.22 = 4 922

On the orientation of some molecules and crystals by the magnetic field. II. Contribution to the study of anti-ferromagnetism. BIZETTE, H. *Ann. Phys., Paris*, **1**, 306–334 (*May–June*, 1946) *In French.*—An antiferromagnetic substance is characterized by a temperature T_λ at which there is an anomaly in the heat capacity and a maximum in the susceptibility. These phenomena are attributed to secondary exchange forces between the metal ions, even though they are separated by non-metallic ions. Below T_λ the susceptibility increases approximately linearly with the applied field. In single crystals there are directions of spontaneous antiferromagnetism that set themselves perpendicular to the applied field, though they may be the directions of easy magnetization at ordinary temperatures. Above T_λ the mean susceptibility of a powdered material is given by the Curie–Weiss law $\chi_M = C_M/(T-\theta)$. Constants for various materials are:

	MnF_2	MnO	MnS	FeF_2	FeO	CoO	$FeCO_3$
T_λ, °K	72	122	165	79	198	271	35–60
C_M	4·08	4·40	4·30	3·88	6·24	—	3·49
$-\theta$, °K	113	610	528	117	570	—	14

Manganese selenide shows antiferromagnetic phenomena, but there is marked thermal hysteresis. For NiO T_λ, if it exists, is above 400°K. The temperature T_λ of these compounds decreases with the electropositiveness of the metallic constituent and the electronegativity of the non-metallic constituent. A. J. C. W.

538.222 : 539.152.2 *see Abstr.* 943

ELECTROMAGNETISM .. ELECTRODYNAMICS 538.3/.5

538.3 : 537.122 : 530.14 *see Abstr.* 747

538.312 : 537.222 *see Abstr.* 870

538.566 : 621.396.11 = 82 923

Radio-wave field in the space between two semi-conductors. RIAZIN, P. A., AND BREKHOVSKIKH, L. M. *Bull. Acad. Sci. URSS, Sér. Phys.*, **10** (*No.* 3) 285–305 (1946) *In Russian.*—[Abstr. 1021 B (1947)].

538.566.3 : 551.510.535 924

Equivalent path and absorption in an ionospheric region. JAEGER, J. C. *Proc. Phys. Soc., Lond.*, **59**, 87–96 (*Jan.*, 1947).—Numerical values for a wireless wave incident vertically on a Chapman region are given for the cases of penetration and of reflection from either side of the region. They are compared with those for the commonly assumed parabolic distribution of ionization. The application of the results to absorption measurements and to the reduction of experimental P', f curves is considered. A.

538.566.3 : 621.396.11 925

Oblique radio transmission in the ionosphere, and the Lorentz polarization term. BEYNON, W. J. G. *Proc.*

Phys. Soc., Lond., **59**, 97–107 (*Jan.*, 1947).—The application of the Sellmeyer and Lorentz dispersion formulae to the problem of oblique reflection of radio waves from a parabolic type of layer is discussed, and the analysis applied to experimental measurements of the maximum usable frequency at oblique incidence over distances of 1 000 km and 700 km. The results are in much closer agreement with values calculated from the Sellmeyer type of formula than from the Lorentz formula, thus confirming the theoretical conclusion of Darwin [Abstr. 372 (1944)]. A.

538.566.3 : 621.396.11 926

The oblique reflexion of very long wireless waves from the ionosphere. WILKES, M. V. *Proc. Roy. Soc. A*, **189**, 130–47 (*March* 27, 1947).—An attempt is made in the paper to provide a satisfactory theoretical basis for a future discussion of experimental data [Abstr. 4906 (1936), 2655 (1939)] on the propagation of very long radio waves (18 800 m). The reflexion of very long plane waves incident obliquely on a horizontally stratified ionized medium with a vertical magnetic field is first considered in general terms, and it is shown that the medium can be divided into a transition region and a reflecting region. If the ionization in the reflecting region increases linearly with height it is shown that propagation is governed by the following equations:

$$\partial^2 L/\partial\zeta^2 + (\alpha + \zeta)L + \beta M = 0,$$
$$\partial^2 M/\partial\zeta^2 + (\alpha - \zeta)M + \beta L = 0,$$

where α and β are constants depending on the angle of incidence. Under the conditions of the experiments β is small, and a solution, in terms of contour integrals, valid in this case is obtained. A.

538.569.4.029.64 : 539.13 927

Absorption of microwaves by gases. II. WALTER, J. E., AND HERSHBERGER, W. D. *J. Appl. Phys.*, **17**, 814–22 (*Oct.*, 1946).—[See Abstr. 2351 (1946)]. The absorption coefficients and permittivities of 16 gases have been measured at the two wavelengths $\lambda = 1{\cdot}24$ cm and $\lambda = 3{\cdot}18$ cm. The gases are H_2S, COS, $(CH_3)_2O$, C_2H_4O, C_2H_5Cl, SO_2, NH_3, 6 halogenated methanes and 3 amines. Improvements in technique are described, which permit detection of absorption coefficients as small as $0{\cdot}2 \times 10^{-4}$ cm^{-1} and measurement of larger coefficients with an accuracy of $\pm 5\%$. The measured permittivities at these wavelengths are essentially equal to the static values. A quantitative interpretation of the absorption coefficients in terms of the known structure and spectra of the individual molecules is given. The theory indicates that all non-planar molecules which possess a permanent dipole moment should show appreciable absorption in the microwave region. A.

MAGNETIC EFFECTS 538.6

538.61 : 538.22 = 4 *see Abstr.* 921

538.614 928

Determination of the magneto-optic anomaly of some glasses. RAMASESHAN, S. *Proc. Indian Acad. Sci. A*, **24**, 426–32 (*Nov.*, 1946).

538.614 = 4 929

Magnetic rotativities. DE MALLEMANN, R. *Ann. Phys., Paris*, **17**, 361–430 (*Sept.–Dec.*, 1942) *In French.*—It has been pointed out that values of the magnetic rotatory power (Λ) of a compound vary with its physical state. A new physical quantity, the *magnetic rotativity* (Ω) has been suggested. It is analogous to the optical refractivity (R) and is independent of the physical state of a compound provided that the molecules are not affected by change of state; an expression connecting Λ and Ω, analogous to the Lorenz equation, is suggested. Th differences between the experimental and theoretic values are a measure of the atomic or molecular d formations; all values are taken on the basis of the ide gas as reference. Λ is the sum of atomic rotativitie Certain restrictions limiting the additivity of these valu are discussed. Numerical values of Λ are calculate from R values and compared with the experimenta values. Values of Λ for elements, and for aliphatic an aromatic compounds have been tabulated. These valu are used to elucidate chemical structure in the same wa as R values have been used. The method is speciall suitable for deciding between two alternative structura formulae for a compound. Attention is directed to th atomic rotativities of O and N in different functiona groups; and to single, double and triple bound C i various classes of organic compound. W. R. A

ATOMIC AND MOLECULAR STRUCTURE 53

539.11 : 535.23 : 536.63 *see Abstr.* 865

539.11 : 539.152.1 *see Abstr.* 941

539.13 : 535.343.4–14 *see Abstr.* 828, 829, 830

539.13 : 537.563 93

Helium molecular energy states as detected by collision of the second kind in helium. MEYEROTT, R. *Phys. Rev.* 70, 671–9 (*Nov.* 1 *and* 15, 1946).—From a survey of th literature on spectra enhanced by collisions of the secon kind, which take place in He, evidence is presented fo the existence in measurable concentrations of both th molecule-ion and the metastable molecule. From th intensity distribution of the enhanced spectra, th repulsive energy between two He atoms at separation of 1·052 Å and 1·090 Å is derived to be 6·8 V and 5·8 V respectively. The rates of formation of the molecula states are discussed in the special case of a steady-stat discharge, and the molecular states are shown to be very probable at high pressures. From this it is shown tha the ion whose mobility is found to be 21·4 cm^2/sec vol is probably that of He_2^+ in helium and, hence, th discrepancy between the theoretical and experimenta values of the mobilities can be removed by such ar interpretation. The existence of neon molecules is also suggested. A

539.13 : 538.569.4.029.64 *see Abstr.* 927

539.132 : 533.15 : 533.7 *see Abstr.* 777

539.132 : 534.222 *see Abstr.* 785

539.132 : 535.338.4 *see Abstr.* 822

539.132 : 541.57 = 3 931

Quantum theory of directed valency. I. Eigenfunction and valence state of the central atom. ARTMANN, K. *Z. Naturforsch.*, **1**, 426–32 (*Aug.*, 1946) *In German.*—In this presentation the valence directions are obtained as the directions of maximum amplitude of a many-particle wave-function for all valence electrons. This function is simply a Slater determinant of the elementary one-electron (s or p) wave-functions. The replacement in the determinant of these elementary functions by linear combinations of them does not alter the results. It is to this extent in contrast with the Pauling directed-valence theory, where the wave-function is a product of one-electron functions which are linear combinations of elementary functions chosen to give maximum amplitude in a certain direction. The forms of H_2O, NH_3, CH_4 are explained, and the plane configuration of BF_3. On this theory the hexagonal form of benzene is due more to the three main 120° bonds of each C atom than to the

shared electrons. A discussion from the viewpoint of olecular structure is to be given in a second part.
G. J. K.

9.133 932

The potential function of benzene. BAK, B. *K. Danske densk. Selsk. Mat.-fys. Medd.*, **22** (*No.* 9) 31 *pp.* (1945). Fifteen of the 34 force constants of C_6H_6 and isotopic olecules are calculated from infra-red and Raman ectra. A. G. G.

9.133 933

The potential function of methane. BAK, B. *K. Danske densk. Selsk. Mat.-fys. Medd.*, **22** (*No.* 16) 33 *pp.* 946).—Numerical values of 5 harmonic force constants CH_4 and deuterated methanes are calculated from fra-red and Raman spectra. A. G. G.

9.133 934

A new method of measuring the electric dipole moment d moment of inertia of diatomic polar molecules. UGHES, H. K. *Phys. Rev.*, **70**, 570 (*Oct.* 1 *and* 15, 946).—This paper reports on experiments in which the olecules of a molecular beam are caused to undergo transition in a steady homogeneous electric field by oscillating electric field at right angles to the d.c. mponent. The method is, therefore, closely analogous the magnetic resonance method, and can be con-dered as an advance over previous methods, in that single rotational state of the molecule is studied even ough it is present to only one part in ten thousand as component of the beam. A.

9.133 935

Effects of high initial energies on mass spectra. WASH-URN, H. W., AND BERRY, C. E. *Phys. Rev.*, **70**, 559 *Oct.* 1 *and* 15, 1946).—It has been found that the umber of ions of a given mass able to traverse the slit ystem of a mass spectrometer of given geometry is a nction of V/V_T, where V is the accelerating voltage, nd V_T the voltage equivalent corresponding to the bsolute temperature (including any dissociation energy) the ion in question. This can be used for finding the ssociation energies of the ions, and the method is here lustrated by application to experimental curves obtained r a number of ions obtained from *n*-butane.

39.133 : 536.7 *see Abstr.* 868

39.133 : 541.57 : 536.654 *see Abstr.* 866

39.152.1 936

Neutron diffraction and nuclear resonance structure. ORST, L. B., ULRICH, A. J., OSBORNE, C. L., AND ASBROUCK, B. *Phys. Rev.*, **70**, 557 (*Oct.* 1 *and* 15, 946).—Summarized results are given for the energies E, alf-widths, cross-sections σ, and $\int\sigma E^{\frac{1}{2}}dE$ of the levels of n^{115}, Rh^{103}, Sm^{149}, En^{151}, Eu^{153} and Gd^{157}. The Sm vel obeys the Breit–Wigner resonance formula within xperimental error.

39.152.1 937

Resonance reactions. WIGNER, E. P. *Phys. Rev.*, **70**, 06–18 (*Nov.* 1 *and* 15, 1946)—The considerations of a revious note [Abstr. 2930 (1946)] are extended to nclude the possibility of several resonance levels. It is hown, in the case of resonance scattering, that it is ossible to write the cross-section as the square of a atio of two expressions, which are themselves fractional xpressions of the energy; or as the square of a single ractional expression of the energy, but in this case the oefficients of the fractional expression are slowly arying functions of the energy and are not real, but ubject to other, more involved, limitations. The results re quite similar if, in addition to scattering, a reaction s possible also. The cross-sections can be evaluated in a simple closed form only if either there is only one pair of reaction products possible (in addition to the reacting pair), or if there are only two resonances present. It is shown, however, that the cross-sections can be repre-sented also in the usual form, but the "constants" of this form are not strictly independent of energy and not real any more, but subject to more involved restrictions. It turns out that the cross-section = 0 between con-secutive resonances if only elastic scattering is possible. The elastic scattering cross-section $\neq 0$ in general for any value of the energy if a nuclear reaction or inelastic scattering is also possible. If the collision can yield, instead of the colliding pair of particles, only another pair, the cross-section for the production of this pair = 0 between successive resonances if the product of certain real quantities has the same sign for both resonances. If the collision may result in any of three or more pairs of particles (e.g. $H^2 + H^2 \rightarrow H^1 + H^3$, or He^3 + neutron, or $He^4 + \gamma$), no cross-section will vanish, in general, for any value of the energy. The considerations of the present paper are restricted to the case in which the relative angular momenta of the reaction products as well as of the reacting particles vanishes. A.

539.152.1 938

Resonance fluorescence of nuclei. SCHIFF, L. I. *Phys. Rev.*, **70**, 761–2 (*Nov.* 1 *and* 15, 1946).—Investigation of energy states of nuclei is suggested by irradiation with a continuous γ-ray spectrum, and observation of radiation at a large angle to the beam. It is shown that the "fluorescence" lines should be intense enough to stand out above the continuous background, due to non-resonant nuclear scattering, and double processes.

539.152.1 939

Surface tension of nuclear matter and the enumeration of eigenfunctions of an enclosed particle. KOTHARI, D. S., AND AULUCK, F. C. *Nature, Lond.*, **159**, 204–5 (*Feb.* 8, 1947)—The effect on the enumeration of the surface, term is applied to the statistical properties of nuclei, adopting the free-particle model (neutron-proton gas). A straightforward calculation, involving no assumptions about nuclear forces, gives for the surface-dependent term of nuclear energy the value $G = \Gamma A^{\frac{1}{3}}$, where A is the mass number of the nucleus, and Γ is about 20 MV. The value of Γ deduced from empirical data on nuclear binding energies is ~ 10 MV.

539.152.1 : 530.145 = 3 *see Abstr.* 750

539.152.1 : 530.145.6 940

Theory of nuclear Coulomb energy. FEENBERG, E., AND GOERTZEL, G. *Phys. Rev.*, **70**, 597–602 (*Nov.* 1 *and* 15, 1946).—The characteristic oscillatory behaviour of the Coulomb energy differences for light nuclei is explained in terms of the different values of the average Coulomb interaction between two particles when the wave function is, respectively, symmetrical and antisymmetrical in the space co-ordinates of the particles. The possible effect of the low binding energy of the least strongly bound particle in $4n + 1$ nuclei is discussed. It is shown how the Coulomb energy differences obtained empirically from odd nuclei may be used to estimate Coulomb energy differences for various other cases. A.

539.152.1 : 539.11 941

Nuclear magnetic resonance at low temperatures. ROLLIN, B. V., AND HATTON, J. *Nature, Lond.*, **159**, 201 (*Feb.* 8, 1947).—Previous measurements [Abstr. 412 (1947)] were extended to liquid hydrogen temperatures. Liquid and solid H gave much stronger signals than substances at room temperature; the line was $<0{\cdot}5$ gauss (2 kc/s) wide, and relaxation time <1 sec; no change was

observed on solidification. The Li and F resonances were observed in LiF and the Na resonance in NaF.

539.152.1 : 539.172.13 *see Abstr.* 987

539.152.2 942

Measurements of nuclear quadrupole moment interactions. NIERENBERG, W. A., RAMSEY, N. F., AND BRODY, S. B. *Phys. Rev.*, **70**, 773–5 (*Nov.* 1 *and* 15, 1946).—A molecular beam resonance method was used in which a large number of rotational states were excited, and the results are interpreted in the light of the statistical theory of Feld and Lamb [Abstr. 1922 (1945)]. Results give the well-established value of 3/2 for the spin of Na^{23}, and so may be extended to other substances.

W. E. D.

539.152.2 : 538.222 943

Paramagnetic losses in two manganous salts. CUMMEROW, R. L., AND HALLIDAY, D. *Phys. Rev.*, **70**, 433 (*Sept.* 1 *and* 15, 1946).—Measurements similar to Abstr. 1351 (1946) were made at 3 000 Mc/s on $MnSO_4 . 4H_2O$ and $MnCl_2 . 4H_2O$. The resonance of the former appeared at a higher magnetic field than indicated theoretically for Mn^{++}, by an amount which could be accounted for [Frenkel, *J. Phys. USSR*, **9**, 299 (1945)] by a relaxation time $\sim 10^{-9}$ sec, or somewhat larger at −65°C. $MnCl_2$ had a shorter relaxation time.

539.152.2 : 539.185 944

Magnetic moments of the neutron and the deuteron. ARNOLD, W. R., AND ROBERTS, A. *Phys. Rev.*, **70**, 766 (*Nov.* 1 *and* 15, 1946).—The ratio of the magnetic moments were measured by a resonance method, which gave $0{\cdot}68479 \pm 0{\cdot}0004$ for the neutron-proton ratio, and $0{\cdot}30702 \pm 0{\cdot}0001$ for the deuteron-proton ratio; taking the proton magnetic moment to be exactly $2{\cdot}7896$ nuclear magnetons leads to magnetic moments of $-1{\cdot}9103 \pm 0{\cdot}0012$ for the neutron and $0{\cdot}85647 \pm 0{\cdot}0003$ for the deuteron. These figures lead to the result that the ground state of the deuteron contains an admixture of 4·0% ^3_1D, compared with 3·9% deduced from the quadrupole moment.

W. E. D.

539.155.2 945

Proposal of a method for the separation of He^3 from He^4. FRANCK, J. *Phys. Rev.*, **70**, 561 (*Oct.* 1 *and* 15, 1946).—It is suggested that He^3 might be separated from He^4 by its failure to become superfluid in consequence of its odd nuclear spin and Fermi–Dirac statistics. The He^4 would be removed from a container of liquid He by superfluid transport. As He^3 is only present in a concentration of 10^{-7} or 10^{-8}, about 10 l of liquid He would be needed.

539.155.2 946

The isotopic constitution of tungsten, silicon, and boron. INGHRAM, M. C. *Phys. Rev.*, **70**, 653–60 (*Nov.* 1 *and* 15, 1946)—The following results are reported:—**W:** 180 (0·122%), 182 (25·77%), 183 (14·24%), 184 (30·68%), 186 (29·17%). **Si:** 28 (92·28%), 29 (4·67%), 30 (3·05%). **B:** 10 (18·83%), 11 (81·17%). Upper limits for the existence of other hypothetical normal isotopes in the immediate neighbourhood of the known isotopes are given.

A.

539.155.2 947

Panoramic mass spectrometer observation. FORRESTER, A. T., AND WHALLEY, W. B. *Rev. Sci. Instrum.*, **17**, 549–52 (*Dec.*, 1946).—In order to facilitate mass spectrometer observation, a low frequency scanning system was used to obtain mass-current curves on the face of an oscilloscope tube. The maximum sensitivity obtained was 5×10^{-14} A/cm vertical deflection. This was limited by the input capacity, the sweep frequency, ar the available amplification.

539.155.2 : 535.33.03 94

Production of Hg^{198} as a possible source of an improve wavelength standard. WIENS, J. H. *Phys. Rev.*, **70**, 91(14 (*Dec.* 1 *and* 15, 1946).—The green line 5 461 Å from an of the even isotopes of Hg is superior, in many respects, t the red line 6 438 Å of Cd. Hg^{198} was produced b utilizing the reaction $_{79}Au^{197} + n \rightarrow {}_{80}Hg^{198} + \beta$. On oz of pure Au sealed into a quartz tube with pure A 4 mm Hg pressure was exposed to stray neutrons fro a cyclotron for 10 months; the Hg produced was the distilled into an attached capillary and the spectrum c an h.f. discharge observed with a Fabry–Perot etalor Hg lines in the correct position for the isotope of mas 198 were observed. The production of larger amount should present no difficulties.

RADIOACTIVITY . NUCLEAR DISINTEGRATION NUCLEAR PARTICLES 539.16/.18

539.16 : 551.510.42 *see Abstr.* 1069, 1070, 1071

539.16.08 : 537.591 94

A report on the Wilson cloud chamber and its applica tions in physics. DAS GUPTA, N. N., AND GHOSH, S. K. *Rev. Mod. Phys.*, **18**, 225–90 (*April*, 1946).—A detailed survey of the physics of drop formation, types of clou chamber and the technique of cloud chamber operatio and of track measurement, together with a short sum mary of cloud chamber applications in nuclear an cosmic ray physics. The numerical data supplied is o particular value. An extensive bibliography covers al aspects of the subject up to 1939 and, as regards Americar work, up to 1944.

J. G. W

539.16.088.4 95(

A note on the correction of Geiger-Müller counter data MANN, H. B. *Quart. Appl. Math.*, **4**, 307–9 (*Oct.*, 1946) —[See Abstr. 135 (1946)].

539.163 95

On the level scheme of Mg^{24} and the mass of Na^{24}. SACHS, R. G. *Phys. Rev.*, **70**, 572 (*Oct.* 1 *and* 15, 1946).—Siegbahn's allocation [Abstr. 3195 (1946)] is criticized on the grounds of the undesirably high mass it gives fo Na^{24}. An alternative scheme is outlined, having two levels in Mg^{24} at 1·38 and 2·76 MeV, the 1·38 MeV γ-ray being in reality two equal cascading rays, and the 2·76 MeV ray being independent. The mass of Na^{2} would be 23·99745.

539.163 952

Half-life of uranium (234). CHAMBERLAIN, O. WILLIAMS, D., AND YUSTER, P. *Phys. Rev.*, **70**, 580–2 (*Nov.* 1 *and* 15, 1946).—Two independent methods were used. The first involved a re-measurement of the relative isotopic abundance of U^{234} and U^{238} in normal U; a value $(2{\cdot}29 \pm 0{\cdot}14) \times 10^5$ years) could then be obtained in terms of the known half-life of U^{238}. The second method involved the determination of the specific α-activity of U^{234} from the total specific α-activity and relative isotopic abundances of several enriched U samples, and gave a value of $2{\cdot}35 \pm 0{\cdot}14 \times 10^5$ years. Both are somewhat smaller than the currently accepted value of $2{\cdot}69 \pm 0{\cdot}27 \times 10^5$ years.

A.

539.163 953

Discovery, identification and characterization of 2·8 d Ru^{97}. SULLIVAN, W. H., SLEIGHT, N. R., AND GLADROW, E. M. *Phys. Rev.*, **70**, 778 (*Nov.* 1 *and* 15, 1946).

).163 954
Mass spectrographic confirmation of the isotopic ignment for the long-lived radioactivity in beryllium. RCE, A. K., AND BROWN, F. W. *Phys. Rev.*, **70**, 779 ov. 1 *and* 15, 1946).—The long-life Be isotope is shown be Be^{10}. W. E. D.

).163 955
Radioactive isotope of gold, $_{79}Au^{198}$ and low energy ge of its spectrum. JNANANANDA, S. *Phys. Rev.*, **70**, 2–14 (*Dec.* 1 *and* 15, 1946).—The spectrum obtained h a magnetic lens β-ray spectrometer shows a broad e at $H\rho = 837{\cdot}5$, which is attributed to secondary ays ejected from the *L*-level of Au by non-corpuscular liation. This must, therefore, have an energy of ·3 keV, or $\lambda = 175{\cdot}7$ X.U., which is identical with the $_1$ line of Hg. Evidence is also found for another erlapping group in the spectrum, due to a radiation a keV softer, which could be the *K*-radiation of ^{198}. Thus $_{79}Au^{198}$ appears to have a dual transition, $_{80}Hg^{198}$ by β-decay or $\rightarrow {}_{78}Pt^{198}$ by *K*-capture. [See ostr. 2024–5 (1939)]. A.

9.163 = 3 956
Energy states of 44 hr lanthanum and of element 93. ILIPP, K., AND RIEDHAMMER, J. *Z. Naturforsch.*, **1**, 2–6 (*July*, 1946) *In German.*—The 44 hr La isotope oduced in U fission is shown to emit a β- and a γ-ray ich are shown by coincidence measurements to be upled, the maximum energy of the β-rays being ·5 MeV, and the γ-ray energy, as deduced from absorp- on measurements, being 1·82 MeV. The ½-life of La^{140} as found to be $43{\cdot}7 \pm 0{\cdot}5$ hr, and when plotted on a rgent diagram it lies between the second and third rves, thus suggesting a spin change of 1 or 2. Np^{239} nits a single β-group of maximum energy 0·48 MeV, so linked with a γ-ray of energy 0·5 MeV. Further- ore, three γ-rays of energies 208, 226 and 276 keV are quired to explain the β-ray line spectrum. The ½-life Np^{239} is $2{\cdot}31 \pm 0{\cdot}11$ d, and its position on the rgent diagram indicates no change of spin with emission. W. E. D.

39.163.1 957
Half-life of C^{14}. REID, A. F., DUNNING, J. R., KINHOUSE, S., AND GROSSE, A. V. *Phys. Rev.*, **70**, 431 ept. 1 *and* 15, 1946).—Accurate measurements are scribed which yielded a value of 4 700 years ±5 to 10%).

39.163.1 958
Half-life determination of C^{14} with a mass spectro- eter and low absorption counter. NORRIS, L. D., AND NGHRAM, M. G. *Phys. Rev.*, **70**, 772–3 (*Nov.* 1 *and* 15, 946).—The ½-life is given as 5 300 years ±15%. W. E. D.

39.163.1 959
Decay scheme for Te^{121}. BURSON, S. B., BITTENCOURT, . T., DUFFIELD, R. B., AND GOLDHABER, M. *Phys. Rev.*, 9, 566 (*Oct.* 1 *and* 15, 1946).—The metastable state has n excitation energy of ~275 keV, and the transition to e ground state takes place in 2 steps: a 225 keV γ-ray preceded or followed (within $0{\cdot}8 \times 10^{-6}$ sec) by a rongly converted γ-ray of ~50 keV. The ground state f Te^{121} decays (½-life, 17d) by *K*-capture to Sb^{121} which usually left in an excited state of 610 keV. The xperiments leading to these conclusions are described.

39.163.1 960
A metastable state of 22 microseconds in Ta^{181}. DEBENEDETTI, S., AND MCGOWAN, F. K. *Phys. Rev.*, **70**, 69 (*Oct.* 1 *and* 15, 1946).—An arrangement to observe elayed coincidences between two counters indicated hat Hf^{181} disintegrates to a metastable state Ta^{181*}, which decays with a ½-life of 22 μsec. The former disintegration is accompanied by β-rays of max. energy ~0·8 MeV, and the latter by β-rays of energy 0·11 MeV, which may be *K*-conversion electrons from γ-rays of energy 0·18 MeV. In addition, 0·5 MeV γ-rays not followed by delayed disintegrations were detected from the Hf.

539.163.1 961
Confirmation of assignment of 2·6 *h* Ni to a mass number of 65. CONN, E. E., BROSI, A. R., SWARTOUT, J. A., CAMERON, A. E., CARTER, R. L., AND HILL, D. G. *Phys. Rev.*, **70**, 768 (*Nov.* 1 *and* 15, 1946).—This was confirmed by the (n, γ) reaction with samples of NiO enriched with various Ni isotopes. W. E. D.

539.163.1 962
"Two-step" isomeric transition in Te^{121}. BITTENCOURT, P. T., AND GOLDHABER, M. *Phys. Rev.*, **70**, 780 (*Nov.* 1 *and* 15, 1946).—It is shown that the 50 keV transition precedes the 225 keV transition, the latter having a ½-life of $(5 \pm 2) \times 10^{-8}$ sec. Eventually, Te^{121} decays from the ground state to an excited state of Sb^{121} of ½-life $< 2 \times 10^{-8}$ sec. W. E. D.

539.163.2 963
Disintegration of $_{17}Cl^{34}$. HO ZAH-WEI. *Phys. Rev.*, **70**, 782–3 (*Nov.* 1 *and* 15, 1946).—It is shown that the positron spectrum of $_{17}Cl^{34}$ is complex, with at least two components of maximum energies of 5·1 MeV and 2·4 MeV, their intensities being in the ratio of 4 to 1. Further, a γ-ray of energy about 3·4 MeV was detected. W. E. D.

539.163.2 964
Low energy alpha-particles from radium. CHANG, W. Y. *Phys. Rev.*, **70**, 632–9 (*Nov.* 1 *and* 15, 1946).—The spectrograph described in Abstr. 1682 (1946) was used; thin uniform Ra sources were deposited on Pt rods. Five previously unknown groups were discovered between 0·5 and 0·9 MeV below the main line, as well as the line at 4·615 MeV found by Rosenblum. The former have intensities 0·02 to 0·05%, the latter 1·8% of the main line. To account for these intensities, a strong interaction between the outgoing particle and the nucleus is postulated, which might imply a transfer of kinetic energy and make the decay probability appear much larger. The total probability of decay and the resultant excitation of the nucleus are discussed. A.

539.163.2 965
Beta-rays from H^3. WATTS, R. J., AND WILLIAMS, D. *Phys. Rev.*, **70**, 640–2 (*Nov.* 1 *and* 15, 1946).—The upper limit of the β-ray spectrum of H^3 has been re-determined by a method involving the passage of β-particles through a thin window into a Geiger counter, aided by an adjustable accelerating field. The effective window thickness was determined by acceleration of electrons from a hot filament. The value obtained for the upper limit is 11 ± 2 keV. A.

539.163.2 = 3 966
93 keV γ-line of UX1. BRADT, H., AND SCHERRER, P. *Helv. Phys. Acta*, **19** (*No.* 5) 307–22 (1946) *In German.*—The β-spectrum of UX_1 has been investigated with a magnetic spectrograph. The upper limit of the spectrum, obtained from a Fermi diagram, is $(0{\cdot}205 \pm 0{\cdot}010)$ MeV. The intensities of the L_1 and unresolved $(M + N)$ conversion lines are 0·051 L_1-electrons and 0·010 $(M + N)$ electrons per disintegration, respectively. The conversion of the 93 keV γ-line of UX_1 in the *L*-shell must give rise to the emission of Pa *L*-radiation, whose intensity is 0·06 *L*-quanta per disintegration. The direct determination by means of a standard UX preparation gives a somewhat higher value (0·1 *L*-quanta per dis-

integration). The absorption of the γ-radiation from UX in Pb is investigated and the absolute intensities of the 93, 180, and 400 keV components are found to be 0·15, 0·045, and 3×10^{-3} quanta per disintegration respectively. The hard UX γ-radiation was investigated by determining the absorption of secondary electrons released by it from an Al plate. The hard radiation is complex, the ratio of the intensities of the (0·8–0·9) and 1·5 MeV components being 9·3 : 1. Comparison with the intensity of the 93 keV line gives the absolute values of the intensities as 2×10^{-2} and 2×10^{-3} quanta per disintegration, respectively. The conversion coefficient of the 93 keV γ-line is calculated from the above-determined intensities. For the L-shell it is 0·34 and for the $(M+N)$ shells together 0·07. The excitation probability of the 93 keV level of the UX_2 nucleus obtained from the intensities of the conversion lines and the unconverted radiation is 20%. A. J. M.

539.163.2 = 3 967

Pair emission of ThC″. Brädt, H., Halter, J., Heine, H. G., and Scherrer, P. *Helv. Phys. Acta*, **19** (*Nos.* 6–7) 431–62 (1946) *In German.*—The positron spectrum of Th(C + C′) has been investigated with a magnetic β-spectrograph, by coincidence measurements with 2 or 3 counters, and with a Wilson chamber of which the expansion was controlled by coincidences of 2 counters in the chamber. With ThC″, as with UX_2, positron emission was indicated by the Wilson chamber method, but not by the other methods. A satisfactory explanation of the coincidence measurements is given. It is shown that the positive tracks in the Wilson chamber are not due to particles originally emitted as pairs. [See Abstr. 546, 832, 3193 (1946)]. A. J. M.

539.163.2 : 539.167.3 968

Absorption curve of 31-second $_8O^{19}$ beta-rays and cross section for production by thermal neutrons. Seren, L., Moyer, W. E., and Sturm, W. *Phys. Rev.*, **70**, 561 (*Oct.* 1 *and* 15, 1946).—The active $_8O^{19}$ was produced by irradiating ordinary distilled water in a fission pile. The β-ray energy obtained from the curve of absorption in Al $\simeq$ 3·3 MeV. This figure is used to obtain a corrected value of $2\cdot2\times10^{-28}$ cm² for the activation cross-section of $_8O^{18}$.

539.165 : 539.166 = 3 969

Absorption method of determining β- and γ-energies. Bleuler, E., and Zünti, W. *Helv. Phys. Acta*, **19** (*No.* 5) 375–98 (1946) *In German.*—An improved method for the evaluation of absorption measurements is described. The course of the absorption curves for known β-spectra is calculated semi-empirically and the energy of an unknown spectrum is obtained by comparison of the absorption curve with this normal curve. The absorption method gives results at least as accurate as the most reliable obtained with the Wilson chamber. New values are given for previously determined β-energies. A similar method can be used for γ-rays, and gives results in good agreement with experimental values. The γ-sensitivity of counter tubes can be calculated approximately. A. J. M.

539.166 : 539.165 = 3 *see Abstr.* 969

539.166.08 : 537.542 *see Abstr.* 896

539.166.2 970

The excitation-function of the γ-radiation generated by Po-α bombardment of Na. Kovács, M. *Phys. Rev.*, **70**, 895–6 (*Dec.* 1 *and* 15, 1946).—The excitation commences at about 1·5 cm α-particle range, attains a small constant level and then starts rising rapidly again at about 2 cm range. The latter emission is correlated with the proton emission from excited Mg^{26} [Abst 4370 (1934)].

539.166.2 97

Angular correlation of gamma-rays. Goertzel, G *Phys. Rev.*, **70**, 896–909 (*Dec.* 1 *and* 15, 1946).—Th calculation of the angular correlation of successi γ-rays from an atomic nucleus [Abstr. 2778 (1940)] h been extended to take into account the effect of t magnetic field at the nucleus because of the extra-nucle electrons. Results are given in a form valid for a multipole orders. In addition, it is shown that a external magnetic field may be used to reduce the effe of the extra-nuclear electrons on the angular correlatio A method of calculating the effect of an extern magnetic field on the angular distribution of the successiv γ-rays is indicated. A

539.166.93 = 3 97

Effect of temperature on the oxidation of ferro sulphate by β- and γ-radiation. Minder, W., an Liechti, A. *Experientia*, **2** (*No.* 10) 410–11 (1946) *German.*—The oxidation of ferrous sulphate in 0·002 aqueous solution by β- and γ-rays from Ra is independe of temperature between 4 and 54°C. The ionic yield 3. Solutions frozen in solid CO_2 are not oxidize Free movement of water molecules is therefore essentia and the absorbed energy is transmitted through distanc up to 65 H_2O-molecules. The authors cannot reconci these results with Weiss's free-radical mechanism fo such reactions. C. B. A

539.167.3 97

Radioactive isotopes in the Columbium region. Wieden beck, M. L. *Phys. Rev.*, **70**, 435 (*Sept.* 1 *and* 15, 1946).— New activities with ½-lives 11 days and 21·6 hours wer observed after bombardment of Co foils by 10 Me deuterons. Both are attributed to Cb^{92} formed in th process $Cb^{93}(d,H^3)$, the threshold for excitation bein ~5–6 MeV. The latter activity consisted of β-rays c 1·2 MeV upper limit, with 0·6 MeV γ-rays.

539.167.3 97

Thresholds for slow neutron induced reactions. Schiff L. I. *Phys. Rev.*, **70**, 562 (*Oct.* 1 *and* 15, 1946).—I ordinary slow neutron capture forms an active compoun nucleus, the energy of the newly formed nucleus i presumably greater than that required for the mode o disintegration in question. The threshold would onl be reached by introducing the neutron with negativ energy. It is suggested that this might be done in measurable way by bombarding the nucleus wit deuterons, and selecting those reactions in which a outgoing proton carries off more energy than th incident deuteron minus the binding energy of th deuteron. This suggestion is discussed with referenc to slow-neutron-induced fission of heavy nuclei.

539.167.3 97

Experimental yields with 14-MeV deuterons. Clarke E. T., and Irvine, J. W., Jr. *Phys. Rev.*, **70**, 893–4 (*Dec.* *and* 15, 1946).—Thick target yields for the production o 17 radioactive isotopes by deuteron bombardment ar reported in terms of absolute disintegrations/sec/μA h of 14 MeV deuterons. A

539.167.3 : 539.163.2 *see Abstr.* 968

539.17 976

Cloud chamber studies of fission fragment tracks. Bøggild, J. K., Brostrøm, K. J., and Lauritsen, T. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No.* 4) 32 *pp.* (1940).—The examination of several hundred photographs enabled the tracks to be divided into two groups, representing particles of different mass and

arge, and velocity-range relations were derived for ch group by counts of branches. There is a steady ear fall over most of the range, and a sharp descent e to nuclear collision at the end, with a flatter portion tween, where velocity loss is a minimum. There is is a sharp contrast with the behaviour of α-particles. A.

9.17 977

The liquid drop model for nuclear fission. PRESENT, D., REINES, F., AND KNIPP, J. K. *Phys. Rev.*, **70**, 7–8 (*Oct.* 1 *and* 15, 1946).—The calculations of Bohr d Wheeler [Abstr. 3979 (1939)] have been extended to gher powers of the deformation parameters, including d harmonics, which correspond to the case of unnmetric fission.

9.17 978

Specific ionization by fission fragments. LASSEN, N. O. *vs. Rev.*, **70**, 577–9 (*Nov.* 1 *and* 15, 1946).—A shallow ization chamber was used to measure the variation ong range of the ionization per unit length by fission gments. Curves giving this variation for each of the o groups of fission fragments were determined; the o curves were found to intersect each other, the heavy oup ionizing more than the light group in the beginning the path and less in later parts. A.

9.17 979

Stopping power of various substances for fission fragents. SEGRÈ, E., AND WIEGAND, C. *Phys. Rev.*, **70**, 8–11 (*Dec.* 1 *and* 15, 1946).—The relative stopping wer of collodion, Al, Cu, Ag, and Au for fission fragents has been measured. The results are similar to ose for α-particles of 4·5 MeV. A.

9.17 : 521.042 980

The freezing-in of nuclear equilibrium. UBBELOHDE, . R. *Proc. Phys. Soc., Lond.*, **59**, 139–44 (*Jan.*, 1947).—xperimental values of abundance ratios of stable otopes, and of their mass differences, are used in a aphical method of testing how far the reaction velocities r different nuclear transformations occur at comparable es under the conditions of freezing-in. With the ited data so far available for exact mass differences p to atomic mass 57, Fe), a single freezing-in parameter approximately 10^{10} deg. c is found to account for a rge proportion of the stable isotopes. However, a fferent origin, or very different reaction velocities for e nuclear transformations, is indicated for some of the able isotopes, such as those of Li. A.

9.17 : 521.042 : 523.877 981

On the abundance of nuclei in the universe. WATAGHIN, . *Phys. Rev.*, **70**, 430–1 (*Sept.* 1 *and* 15, 1946).—[See bstr. 1487 (1946)].

9.17 : 523.112 : 521.042 982

Expanding universe and the origin of elements. GAMOW, . *Phys. Rev.*, **70**, 572–3 (*Oct.* 1 *and* 15, 1946); *ratum*, **71**, 271 (*Feb.* 15, 1947).—Consideration of e relations governing the expansion of the universe ows that the conditions necessary for rapid nuclear actions were probably only existing for a very short me, so that it is not safe to assume that equilibrium nditions could be established before "freezing-in" took ace. This may explain the anomalous distribution of undance of the elements, which may have been formed coagulation of neutrons, with the heavier elements quiring longer time.

9.172 983

The relative probability of the (*d,p*) and the (*d,n*) actions in bombarded bismuth. CORK, J. M. *Phys. ev.*, **70**, 563 (*Oct.* 1 *and* 15, 1946).—The ratio $(d,p)/(d,n)$ as been observed [Abstr. 1503 (1940)] to fall from 10 for 7 MeV deuterons, to about 5 for 9·5 MeV. This is explained by the Oppenheimen–Philips process (dissociation of the deuteron outside the nucleus into a scattered proton and a neutron which proceeds on into the nucleus) which would be expected to diminish greatly at higher energies, so that the ratio would fall to unity or less. Bombardment has now been extended to 14·5 MeV energies, and the ratio has been found to remain at a value of 5.

539.172 984

Nuclear disintegrations produced by slow charged particles of small mass. OCCHIALINI, G. P. S., AND POWELL, C. F. *Nature, Lond.*, **159**, 186–90 (*Feb.* 8, 1947).—Photomicrographs are published of 5 tracks found in the emulsion of photographic plates exposed for 6 weeks at a high altitude, all showing "stars" of disintegrations caused by an ionizing particle. The mass of this particle was estimated in 2 ways: by measuring the rate of variation of grain density along the track, as the particle loses velocity, and comparing with similar data for protons; and by measuring the variation of frequency of Coulomb scattering along the track, and similarly comparing with protons. The resulting values are 100 to 230, and 350 ± 100, times the electron mass, respectively, and the particles are identified with negative mesons. A track, attributed to a positive meson, ending in the emulsion, is also shown.

539.172 : 539.18 : 537.123 985

An example of meson production in lead. ROCHESTER, G. D., BUTLER, C. C., AND RUNCORN, S. K. *Nature, Lond.*, **159**, 227–8 (*Feb.* 15, 1947).—A cloud chamber photograph is published which shows tracks of 2 fast particles entering a Pb plate, and at least 6 particles emerging, 5 of them radiating from a single point. One of them is interpreted definitely as that of a slow negative meson, of momentum $2{\cdot}2 \times 10^7$ eV/c.

539.172.13 986

Resonances in the disintegration of fluorine by protons. BENNETT, W. E., BONNER, T. W., MANDEVILLE, C. E., AND WATT, B. E. *Phys. Rev.*, **70**, 882–90 (*Dec.* 1 *and* 15, 1946).—The voltage regulation of the Rice Institute pressure electrostatic generator has been improved by the use of a modulated electron current which proceeds up the vacuum tube in the opposite direction to the positive ions. The auxiliary apparatus is composed of a magnetic voltage analyzer and an electronic potential regulator. Calculations indicate that at 1 MeV the potential is controlled to ±150 V. The resonances in the production of γ-rays and soft radiation (pairs) when F^{19} is bombarded by protons have been studied with proton energies of from 800 to 1 400 keV. Resonances for the emission of γ-rays have been observed at 820, 862, 890, 927, 1 076, 1 107, 1 122, 1 161, 1 274, 1 335, and 1 363 keV. The experimental ½-widths of these resonance levels vary from 1·9 to 50 keV. Resonances for the production of soft radiation (pairs) have been observed at 832, 1 100, 1 220, and 1 362 keV; the widths of these resonance levels vary from 28 to 85 keV. An explanation of the varying intensities and widths of the levels can be made on the basis that the protons which produce the disintegrations and the α-particles which result have several different values of angular momentum. A.

539.172.13 : 539.152.1 987

Discussion of the fluorine-proton resonances. SCHIFF, L. I. *Phys. Rev.*, **70**, 891–3 (*Dec.* 1 *and* 15, 1946).—Experimental data [Abstr. 986 (1947)] are analysed with the object of making angular momentum and parity assignments to the excited states of Ne^{20} and O^{16}. The

best fit with the data appears to be obtained with a 1^+ oxygen level for the γ-rays (which are then of magnetic dipole character), and a 0^+ oxygen level for the pairs. A.

539.172.4 988

Evidence for the reaction O^{17} (n, α) C^{14}. HINCKS, E. P. *Phys. Rev.*, **70**, 770–1 (*Nov.* 1 *and* 15, 1946).

539.18 : 537.123 989

Multiple scattering and the mass of the meson. BETHE, H. A. *Phys. Rev.*, **70**, 821–31 (*Dec.* 1 *and* 15, 1946).—It is shown that multiple scattering by the atoms of the gas in a cloud chamber can cause large apparent curvature of tracks. This effect makes the measurement of curvature in a magnetic field meaningless if the energy of the particle is small and the magnetic field low. An analysis shows that *all* published meson tracks are compatible with a unique mass of about 200 electron masses. A.

539.18 : 537.123 990

The mean lifetime of the meson. COCCONI, G., AND TONGIORGI, V. *Phys. Rev.*, **70**, 855–9 (*Dec.* 1 *and* 15, 1946).—Measurements of the lifetime of mesons which have traversed varying distances in air have been made and show that the value of $\tau/\mu c^2$ is constant. The existence of a spectrum of lifetimes is therefore excluded. The most probable value of $\tau/\mu c^2$ from the measurements is $2{\cdot}6 \pm 0{\cdot}3 \times 10^{-14}$ sec/eV. A.

539.18 : 537.123 991

On the mean life of slow mesons. CONVERSI, M., AND PICCIONI, O. *Phys. Rev.*, **70**, 859–73 (*Dec.* 1 *and* 15, 1946).—A new investigation on the spontaneous decay of mesons was performed by counting delayed coincidences between low-energy mesons impinging on an Fe plate and the decay electrons. Four points of the decay curve of mesons were obtained for relative delay times ranging between $-0{\cdot}91$ and $2{\cdot}43$ μsec. The results give an exponential curve which is evidence of the decay process. For the mean life we find $\tau = 2{\cdot}33$ μsec $\pm$ 6·5%. The effect disappears completely by inverting the sign of the delay. A.

539.18 : 537.123 : 537.531.8 *see Abstr.* 888

539.18 : 537.123 : 537.591.1 = 4 992

The experimental determination of the mass of mesotrons by ionization methods. GORODETZKY, S. *Experientia*, **2** (*No.* 11) 421–30 (1946) *In French.*—All the different methods are reviewed, and three ionization methods discussed in detail: ionization loss; range; and momentum loss on passing through a solid plate. The last of these is given the fullest treatment, and a set of curves is presented enabling the mass to be read directly, and the error estimated. The resolving powers of the three methods are compared.

539.18 : 537.123 : 537.591.3 993

On the disintegration of slow mesons. CONVERSI, M., AND PICCIONI, O. *Phys. Rev.*, **70**, 874–81 (*Dec.* 1 *and* 15, 1946).—Measurements designed to give indications about the disintegration process of the mesons stopped in an Fe plate have been performed [Abstr. 991 (1947)]. In agreement with the theoretical predictions of Tomonaga and Araki it was found that only about $\frac{1}{2}$ of the ionizing particles that compose the hard component of the cosmic rays and that are absorbed in an Fe plate, undergo, in effect, the disintegration process. The mean range of the decay-electrons was deduced to be about 2·5 cm of Fe, with a probable precision of 20%. A.

539.18 : 537.123 : 539.172 *see Abstr.* 985

539.181 : 537.533 994

Emission of secondary electrons from nickel and molybdenum by neutral atoms of mercury and potassium. CHAUDRI, R. M., AND KHAN, A. W. *Nature, Lond.*, 15[9] 202 (*Feb.* 8, 1947).—Accelerated positive ions wer[e] neutralized, either by passage through a narrow metall[ic] canal (Hg) or through K vapour (K) [Abstr. 3542 (1930)] and fell on a metal target with energy of 1 200 to 2 000 (K) or 2 500 (Hg) volts. The secondary emission was almos[t] proportional to energy, and the energy distribution wa[s] Maxwellian, corresponding to effective temperatures o[f] 30 000 to 45 000°K (tabulated).

539.185 99[5]

Production of low energy neutrons by filtering throug[h] graphite. ANDERSON, H. L., FERMI, E., AND MARSHALL L. *Phys. Rev.*, **70**, 815–17 (*Dec.* 1 *and* 15, 1946).—Neutrons of energy much lower than thermal wer[e] produced by filtering a beam of thermal neutrons throug[h] a block of graphite 23 cm long. In such a block, Brag[g] scattering removes the neutrons whose wavelength is les[s] than the largest Bragg wavelength in graphite, 6·69 Å. Measurement of the boron absorption of the filtere[d] neutrons showed that they had an effective wavelengt[h] of 7·15 Å which corresponds to neutron temperature[s] around 18°K. The cross-section of graphite for th[e] filtered neutrons is $0{\cdot}70 \times 10^{-24}$ cm². That a part o[f] this is caused by the incoherence due to thermal agitatio[n] of the atoms of the crystal was demonstrated by heatin[g] the crystal and observing the increase in this cross section. The filtered neutrons were used to show inter[-] ference effects in other substances such as Be, Bi, an[d] S. In water a 4× increase in the scattering cross-sectio[n] of H due to chemical binding was observed. A.

539.185 = 4 99[6]

Influence of molecular bonding on the scattering o[f] thermal neutrons by nitrogen. GIBERT, A., KELLER, R. AND ROSSEL, J. *Helv. Phys. Acta*, **19** (*Nos.* 6–7) 493–50[2] (1946) *In French.*—The total cross-section is measured a[t] various temperatures down to 20°K, and the scatterin[g] cross-section, σ_s, deduced by subtracting the known valu[e] for capture. There is a decrease of 13% in the valu[e] of σ_s in passing from the gaseous to the liquid state, th[e] decrease continuing with decreasing temperature, bu[t] there is no change on transition to the solid. However the value for σ_s for the solid state does show some increase as the temperature falls, including an increase in σ_s at the transition point (35·4°K) for solid nitrogen A discussion is given of these results. W. E. D.

539.185 : 539.152.2 *see Abstr.* 944

539.185.08 99[7]

Proposed neutron spectrometer in the 10–1 000 kev range. FELD, B. T. *Phys. Rev.*, **70**, 429 (*Sept.* 1 *and* 15[,] 1946).—A proportional counter filled with gas containing nuclei undergoing a (n,p) reaction liberating a known energy E_r will register pulses of height proportional to $E_r + E_n$, when irradiated with neutrons of energy E_n. Analysis of pulse height distribution would then give information on the distribution of E_n, after correction for variation of cross-section. $N^{14}(n,p)C^{14}$ and $Cl^{35}(n,p)S^{35}$ are discussed as possible reactions.

539.185.7 998

The neutron-proton and neutron-carbon scattering cross sections for fast neutrons. BAILEY, C. L., BENNETT, W. E., BERGSTRALH, T., NUCKOLLS, R. G., RICHARDS, H. T., AND WILLIAMS, J. H. *Phys. Rev.*, **70**, 583–9 (*Nov.* 1 *and* 15, 1946).—Neutrons of discrete energies from 0·35 to 6·0 MeV were produced by particle bombardment of Li, C, and heavy H_2O targets. Transmissions of cyclohexane (C_6H_{12}) and graphite scatterers under conditions of good geometry were measured. Results for σ_s(H) are compared with the theoretical interpretations of Bohm and Richman (to be published later) and to the

perimental results of Frisch at lower energies [Abstr. 9 (1947)]. It is estimated that σ_s(H) and σ_s(C) are termined to approximately 5%. A.

9.185.7 999
The total cross sections of carbon and hydrogen for utrons of energies from 35 to 490 kev. FRISCH, D. H. *ys. Rev.*, **70**, 589–92 (*Nov.* 1 *and* 15, 1946).—Measure-nts are reported. A.

9.185.7 1000
Angular distribution of 2·5-Mev neutrons scattered by uterium. COON, J. H., AND BARSCHALL, H. H. *Phys. v.*, **70**, 592–6 (*Nov.* 1 *and* 15, 1946).—Measurements re made by analysing the distribution in energy of the oiling deuterons in an ionization chamber. In the ntre-of-mass system the differential cross-section nibits a maximum for backward scattering of the utron. The value at the maximum is more than twice value at angles near 90°. Neutron-proton scattering served under similar conditions showed a departure of t more than 10% from isotropic scattering. A.

9.185.7 1001
The total scattering cross sections of deuterium and ygen for fast neutrons. NUCKOLLS, R. G., BAILEY, L., BENNETT, W. E., BERGSTRALH, T., RICHARDS, H. T., D WILLIAMS, J. H. *Phys. Rev.*, **70**, 805–7 (*Dec.* 1 *and* 15, 46).—By observations of the transmission of H_2O and O for neutrons of discrete energies between 0·35 and 0 MeV and from a knowledge of σ_s(H)[1], values of D) and σ_s(O) are deduced as a function of neutron ergy. σ_s(D) is a monotonic function of neutron ergy in this region but σ_s(O) shows evidence for sonance phenomena. A.

9.185.7 1002
Slow neutron resonances in indium. MCDANIEL, B. D. *ys. Rev.*, **70**, 832–41 (*Dec.* 1 *and* 15, 1946).—The utron spectrometer previously described [Abstr. 2160, 05 (1946)] has been improved to permit the use of detector timing channels. It has been used to determine the neutron cross-section for absorption in In as a action of neutron energy in the range extending from 017 to 50 eV. The strong resonance previously served was found to be located at 1·44 eV and two aker resonances were found at about 3·7 and 9·0 eV. e parameters of the Breit–Wigner one-level formula ich best describe the 1·44 eV resonance were $= 26\,400 \times 10^{-24}$ cm² and $\Gamma = 0{\cdot}085$ eV. The resolution did not permit a similar analysis for the levels higher energy, and it was only possible to place rough wer limits for the values of the cross-section at sonance. A.

9.185.7 1003
Neutron polarization and ferromagnetic saturation. OCH, F., CONDIT, R. I., AND STAUB, H. H. *Phys. Rev.*, , 972–3 (*Dec.* 1 *and* 15, 1946).—See Abstr. 2853 (1943). rther experiments with magnetizing fields up to 000 gauss showed that the former values for neutron ensity change on passing through saturated iron were low, the new values being 6·8% for ¾ in, and 24·8% 1½ in plates. These values do not give the same value λ, the linear dimensions of the microcrystals, and it possible that the average velocity of the neutron beam altered by passage through the iron.

STRUCTURE OF SOLIDS 539.2

9.215 : 539.23 : 538.114 *see Abstr.* 918

9.215.4 : 548.734.3 *see Abstr.* 1047

9.216 : 677 : 539.41 *see Abstr.* 1017

539.217.5 : 533.15 1004
The permeability of different rubbers to gases and its relation to diffusivity and solubility. VAN AMERONGEN, G. J. *J. Appl. Phys.*, **17**, 972–85 (*Nov.*, 1946).

539.23 : 535.417 *see Abstr.* 846, 847

539.23 : 537.311.1 : 535.39 = 4 1005
Thin metallic films. ARON, A. *Ann. Phys., Paris*, **1**, 361–493 (*July–Aug.*, 1946) *In French.*—A critical review. A film is defined as thin when its properties differ from those of the bulk metal. Part I (25 pages) describes seven methods of preparation, of which sputtering and evaporation are the most important. The nature of the sputtered particles is discussed in detail. There are 32 references. Part II emphasizes the difficulty of determining the thickness, then describes the physical properties (electrical, 15 pages; optical, 31 pages; magnetic, 7 pages) and the chemical properties (19 pages). There are 68 references. Part III (26 pages) describes the structure of the films and their practical applications. It ends with a brief summary of the theory of reflection, refraction and electrical conduction in thin films. There are 44 references. A. J. C. W.

539.23 : 539.215 : 538.114 *see Abstr.* 918

539.26 1006
X-ray microradiography of distorted crystals. SMOLUCHOWSKI, R., LUCHT, C. M., AND MANN, M. *Phys. Rev.*, **70**, 318–22 (*Sept.* 1 *and* 15, 1946).—X-rays passing through a thin metal sheet suffer reflection in suitably-oriented grains, producing mottling of the radiograph. Tilting the sheet changes the grains that are in a reflecting orientation, and so changes the pattern. The range of tilt over which a given grain reflects gives information on the nature and amount of its lattice deformation. Microradiographs of strained and strain-free Cu foil are reproduced; it is found that the reflecting planes are (111). A. J. C. W.

539.26 : 539.4.016.2 : 548.73 *see Abstr.* 1046

539.264 1007
Fine structure of viscose rayon. INGERSOLL, H. G. *J. Appl. Phys.*, **17**, 924–39 (*Nov.*, 1946).—Quantitative X-ray diffraction methods have been used to study the orientation of the cellulose chains and lateral ordering around the long chain axes in various commercial and experimental rayons. A.

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.31 1008
On the elastic properties of lattices. EPSTEIN, P. S. *Phys. Rev.*, **70**, 915–22 (*Dec.* 1 *and* 15, 1946).—The potential energy of a deformed lattice can be written in the form $V = V_0 + V_1 + V_2$, where V_0 is a constant (the energy of the undeformed lattice), V_1 the part linear in the displacements of the lattice points from their normal positions, V_2 the part quadratic in the displacements. The terms of higher order are neglected. In view of the requirement that the normal position of each lattice point be a position of equilibrium the linear part vanishes ($V_1 = 0$) so that the energy is simply equal to V_2 (apart from the constant V_0). As the energy must be invariant with respect to rotations of the system, W. Voigt postulated the invariance of V_2 and derived from this assumption the so-called Cauchy relations between the elastic coefficients. A closer analysis shows that the term V_2 represents the energy only because of the subsidiary condition $V_1 = 0$ which, upon investigation, turns out to be not invariant with respect to rotations. Hence,

V_2 is not invariant either: a fact which removes the theoretical basis of the Cauchy relations. A.

539.32 : 548.0 = 3 *see Abstr.* 1038

539.32 : 549.211 : 548.0 *see Abstr.* 1039

539.37 : 535.55 1009

Stress-optical properties of rubber. TRELOAR, L. R. G. *Nature, Lond.*, **159**, 231 (*Feb.* 15, 1947).—Observations of birefringence of a stretched sheet of rubber swollen in paraffin gave results in accordance with the author's theory. The stress in one of the principal directions was, however, related to the principal extensions by a stepped curve, which is to be expected under Mooney's theory [Abstr. 2892 (1940)].

539.374 1010

Internal friction and plastic extension of zinc single crystals. READ, T. A., AND TYNDALL, E. P. T. *J. Appl. Phys.*, **17**, 713–20 (*Sept.*, 1946).—Data are given on the internal friction of 4 single crystals of Zn while oscillating longitudinally, and slow-speed tension tests are described on a fifth crystal within and beyond the elastic limit. In the first measurements the behaviour of the crystals little resembles that of Zn crystals of greater purity prepared by another method [Abstr. 2883 (1940)]. The leading feature is that the decrement, although higher at the lowest stress amplitude than for the previous ones, shows very little rise with increasing stress amplitude, even up to stresses far beyond the statically-determined elastic limit. The difference in behaviour seems to be caused by the difference in purity of the zincs. An optically mosaic structure does not appear to be responsible. In the slow-speed tension tests the Zn crystal, after a period of self-annealing at room temperature, has a Hooke's law region up to about 70 g/mm^2 and at greater stress shows transient and steady creep. Under some circumstances the transient creep is in two parts, a slow starting creep followed by much more rapid creep. The crystal, when measured following a permanent strain, shows creep at loads well below the previous elastic limit and has a large amount of hysteresis. Self-annealing occurs during rest periods and the initial elastic limit is gradually regained while the hysteresis disappears. A.

539.374 1011

Plastic strain in isotropic strain-hardening material. SWIFT, H. W. *Engineering*, **162**, 381–4 (*Oct.* 18, 1946).—This paper is concerned with the characteristics of plastic strain in a hypothetical material which "hardens" under strain, but remains isotropic. An attempt is made to ascertain what features of strain-hardening as revealed by experiment are consistent, and what inconsistent, with isotropy in the material. The Mohr circle diagram for stress is extended to cover large and small strains, and in particular to show the directions of shear stresses and strains. Stress-strain relationships in the plastic region are discussed with reference to: (1) The conditions for inception of plastic strain. (2) The geometry of plastic strain in relation to the stress system. (3) The amount of overstrain induced by a given excess of stress. In a discussion of strain-hardening characteristics, it is pointed out that isotropy does not require that the strain-hardening rate for a given material should be independent of the condition. In a final section formulae are developed for reduction of experimental results. L. G. C.

539.374 1012

Plastic flow of metals. HOLLOMON, J. H., AND LUBAHN, J. D. *Phys. Rev.*, **70**, 775 (*Nov.* 1 *and* 15, 1946).—A general relation is derived for plastic flow in metals relating the stress, strain, strain rate and temperature, which is found to conflict with some accepted ideas, but to agree with certain experimental results. W. E. D.

539.374 101

Deformation in relation to time, pressure and temperature. NUTTING, P. G. *J. Franklin Inst.*, **242**, 449–(*Dec.*, 1946).—The paper outlines a possible gener framework into which the special laws of deformatio may be fitted. The linear logarithmic relations betwee deformation and temperature and pressure, previous empirical, have been directly derived from the definir equations for compressibility and thermal expansivity an shown to apply to all three stages of every deformatio Gibbs's thermodynamic potential function is shown t lead directly to simple and exact expressions for th energy of change of phase and of deformation within an one phase. The latter, a general equation of stat amounts to a simple relation between the four intern pressures. The derived deformation and energy fun tions are applied to some experimental data on steel tap which included thermal and relaxation observation Thermodynamic relations governing both elastic an viscous behaviour are developed. Plastic behaviou involves both single-phase and multiple-phase applic tions of the second law. Precise thermal measuremen should give the constants.

539.382 101

A method for obtaining stress-strain relations in nor isotropic flexible sheet material under two-dimension stress. ANDERSON, S. L. *J. Sci. Instrum.*, **24**, 25- (*Jan.*, 1947).

539.4.011.25 101

A thermodynamic criterion for the fracture of metals- reply to a criticism. SAIBEL, E. *Phys. Rev.*, **70**, 77 (*Nov.* 1 *and* 15, 1946).—See Abstr. 3213 (1946).

539.4.011.25 : 531.259.1 *see Abstr.* 754

539.4.016.2 : 539.26 : 548.73 *see Abstr.* 1046

539.4.016.2 : 548.73 101

The system of microstresses in cold-worked meta BLACHMAN, N. M. *Phys. Rev.*, **70**, 698–704 (*Nov.* 1 *an* 15, 1946).—The variation in line width with crystallo graphic direction is computed for several very simp theoretical models of internal-stress systems. [Se Abstr. 724 (1944)]. The one which fits the experiment results best, though poorly, is that which assumes tha the homogeneously strained domains suffer unifor normal stress of random magnitude. A plausible mod for the microstress system and a very good fit a obtained by superposing upon this model any of th other models considered, and thus obtaining the prop amount of anisotropy.

539.41 : 539.216 : 677 101

The elastic properties of textile fibres. MEREDITH, R *J. Text. Inst. Manchr*, **37**, P469–80 (*Oct.*, 1946).—Aft a brief description of the chemical nature of both natur and synthetic fibres, an account is given of the variou elastic properties of such fibres, and how they are affecte by the nature of the chemical chain. The effects on the properties of humidity, temperature and time are the discussed. Comparison is made with steel and copper G. O.

539.431 : 519.21 101

The statistical aspect of fatigue of materials. FRE DENTHAL, A. M. *Proc. Roy. Soc. A*, **187**, 416–29 (*De* 13, 1946).—Fatigue consists of the progressive destructio of the cohesive bonds as a result of the repeated action external loads. A statistical distribution function of th separation-strength of cohesive bonds is assumed an the theory of probability is used to derive some of th experimentally established relations between the princip variables. L. S.

39.501 : 531.31 1019

Limitations of the Newtonian time scale in relation to on-equilibrium rheological states and a theory of quasi-roperties. SCOTT BLAIR, G. W., VEINOGLOU, B. C., AND AFFYN, J. E. *Proc. Roy. Soc. A*, **189**, 69–87 (*March* 27, 947).—To describe the behaviour of complex materials nder stress, "quasi-properties" are introduced, which o not have integral time-exponents on the Newtonian me-scale; they represent an ordered process towards uilibrium rather than a state of equilibrium. In order retain the Newtonian time-scale, fractional differential uations are used. The simplest of these, relating ress, strain and time, integrates to a series equation hose first term is the familiar Nutting equation; the troduction of the second and (very rarely) the third rm improves the fit of experimental results for many aterials not following Nutting's equation. The paratus used for obtaining the experimental results is scribed, and the results on 38 materials quoted. The rm of the series equation indicates that the relative portance of the second term may sometimes disclose e presence of undissipated stresses in the materials. A.

539.501 : 541.18.025 *see Abstr.* 1024

539.536 = 3 1020

Investigations on the abrasive resistance of quartz and other solids in various liquids. V. ENGELHARDT, W. *Nachr. Wiss. Göttingen* (*No.* 2) 7–34 (1942) *In German.*—From considerations of surface energy it is anticipated that the abrasive resistance of solids must depend on the nature of the liquid in which abrasion takes place. Surface-grinding experiments were carried out on quartz with carborundum powder, using various liquids continuously applied in such carefully adjusted quantities that maximum abrasion was ensured. The abrasion surface of the solid was measured, the pressure varied from 0·3–1 kg/cm² in a series of experiments, and the abrasion was measured by the loss of weight of the object. The hardness is then expressed as density × grinding surface — weight loss in g by 1 kg/cm² pressure. Relative values (quartz in water = 100) are given for various pure liquids. A theory of the surface energy as the energy of an electrostatic boundary field is developed in detail and accounts for the observed effects. J. A. W.

539.62 : 532.516 : 531.44 *see Abstr.* 758, 759

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.124/.128

41.124 1021

The more recent work on the reaction between hydrogen nd oxygen. HINSHELWOOD, C. N. *Proc. Roy. Soc. A*, **8**, 1–9 (*Dec.* 31, 1946).—The hydrogen-oxygen reaction almost certainly a chain reaction, and an account is ven of the initiation and termination of the chain, and f the rate of reaction. An expression is given for the te of formation of water and this leads to the condition r explosion. The action of alkali salts in suppressing te flash given by propellants is discussed. L. S. G.

41.124 : 541.183 *see Abstr.* 1027

41.128.1 : 542.943 1022

The mechanism of the catalytic oxidation of ethylene. Experiments using a flow system. II. Reactions between hylene, etc., and chemisorbed oxygen monolayers. 1. The reactions between ethylene and oxygen in a static stem. TWIGG, G. H. *Proc. Roy. Soc. A*, **188**, 92–141 Dec. 31, 1946).

ELECTROCHEMISTRY 541.13

41.13 1023

The polarography of uranium. II. Polarography in rongly acid solution. KOLTHOFF, I. M., AND HARRIS, . E. *J. Amer. Chem. Soc.*, **68**, 1175–9 (*July*, 1946).—revious measurements on the polarography of U^{6+} Abstr. 1377 (1946)] yielded two reduction waves, rresponding to the reductions U^{6+} to U^{5+} and to U^{3+} spectively. The first diffusion current increased with idity, and two alternative interpretations of this are ven, involving a disproportionation of the UO_2^+, or rmation of unreducible UO_2OH. Reasons for adopting e former hypothesis are given. It has been found that increases with increasing [U] in 2M HCl, where = ratio of the reduction of U to the tetravalent and ntavalent states respectively. An increasing potential used an increasing current at the Hg electrode; for a ven concentration of U, the rate of U^{5+} decomposition creased with increasing acid strength, and with increas-g temperature. The retardation of the decomposition U^{5+}, due to an excess of U^{4+}, has been evidenced larographically. Change in drop time did not affect the U^{5+} decomposition, and complex formation with various ions is found to increase the value of *R*. W. R. A.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18.025 : 539.501 1024

The characteristic shear value: a coefficient of thixotropic breakdown. SHAPIRO, I. *J. Amer. Chem. Soc.*, **68**, 2122–3 (*Oct.*, 1946).—The coefficient of thixotropic breakdown *V*, has been previously defined by $V = -df/dU$ where f = yield value and U = plastic viscosity. Arguments have been presented to show that V = the rate of shear at the common point of intersection of the up curves for thixotropic breakdown. It has been proposed that V be called the "characteristic shear" value for the material. W. R. A.

ADSORPTION 541.183

541.183 1025

Ageing of surfaces of solutions. VI. Surface ageing of casein solutions. SUBBA RAO, G. N., GURURAJA DOSS, K. S., AND SANJIVA RAO, B. *Proc. Indian Acad. Sci. A*, **24**, 277–86 (*Sept.*, 1946).—The rates of accumulation and rate of change of γ with time were studied, using both ring and trough methods. The observed values of the rate are twice as large as the theoretical values. This may be due to (*a*) undulations produced during the formation of the new surface, (*b*) existence of disturbing eddy currents near the surface. Neither KCl nor $BaCl_2$ alter the rate of accumulation, showing the absence of gegenions or any electrical potential barrier. The temperature coefficient of accumulation is negligible and hence accumulation cannot be activated. The rate of change of γ with time is discussed. W. R. A.

541.183 : 532.61 1026

A new method of investigating the mechanical properties of surface films formed by surface-active substances in aqueous solutions. MATALON, R. *C.R. Acad. Sci., Paris*, **222**, 1213–15 (*May* 20, 1946) *In French.*—This method, which is an extension of one described in 1893 by Proctor Hall and in 1941 by Thibaut and Lemonde, uses a rectangular stirrup which is pulled out of the surface of a solution. Curves are obtained relating the force

required to pull the stirrup out of the surface to the stretching of the film. Results have been obtained for soap solutions, and three types of curve are illustrated, but no details of the soaps are given. The type of curve depends on the concentration of soap and is related to the formation of micelles. Other factors which can be related to the force/extension curves are: foam formation, stability of foams, concentration of active molecules in the surface region and diffusion of molecules from the body of the solution to the surface. J. I.

541.183 : 541.124 1027

Interaction of steam and charcoal at low pressures. STRICKLAND-CONSTABLE, R. F. *Proc. Roy. Soc. A*, **189**, 1–10 (*March* 27, 1947).

541.183 : 545.844 1028

Studies on adsorption and adsorption analysis with special reference to homologous series. CLAESSON, S. *Ark. Kemi. Min. Geol.*, **23 A** (*Nos.* 1–2) *Paper* 1, 133 *pp.* (1946).

541.183.1 1029

Multilayer adsorption equations. EMMETT, P. H. *J. Amer. Chem. Soc.*, **68**, 1784–9 (*Sept.*, 1946).—Brunauer, Emmett and Teller have represented low temperature adsorption data by a kinetically derived equation, and Harkins and Jura by an equation derived from the behaviour of insoluble films on H_2O. The agreement of the two different approaches has been reviewed and their respective limitations are discussed. W. R. A.

CHEMICAL STRUCTURE 541.4/.6

541.57 : 539.132 = 3 *see Abstr.* 931

541.57 : 539.133 : 536.654 *see Abstr.* 866

541.6 : 548.737 1030

The structure of polyisoprenes. VI. An investigation of the molecular structure of dibenzyl by X-ray analysis. JEFFREYS, G. A. *Proc. Roy. Soc. A*, **188**, 222–36 (*Jan.* 30, 1947).

541.61 = 4 1031

Distribution of the electronic cloud and chemical reactivity of condensed aromatic hydrocarbons. PULLMANN, A., AND PULLMANN, B. *Experientia*, **2** (*No.* 9) 364–7 (1946) *In French.*—The authors describe the results of a quantum mechanical treatment of aromatic hydrocarbons enabling the determination of the electronic charge at each point of the molecule. They give the interpretation of the chemical reactivity of these substances by means of "molecular diagrams."

541.66 : 536.412 *see Abstr.* 862

CHEMICAL PROCESSES 542.9

542.921.9 : 537.525 = 4 1032

Action of the electric discharge on water vapour at low pressure. JOLIBOIS, P., AND BOULLÉ, A. *C.R. Acad. Sci., Paris*, **222**, 768–72 (*April* 1, 1946) *In French.*—The decomposition of water vapour in a discharge tube in which it comes into contact only with the positive column of the discharge, and is thus sheltered from electrode phenomena, gives rise solely to H_2 and O_2 in electrolytic proportion. This contrasts with a decomposition in which an excess of dissolved O_2 is interpreted as arising from the polymerization of an intermediately formed OH radical giving an excess of H_2 and the dissolved O_2. The decomposition of the vapour in the positive column of the discharge shows characteristics indicating a pure thermal dissociation; measurement of the extent of dissociation confirms the value of the apparent temperature of the positive column (2 700°K). N. M. B.

542.943 : 541.128.1 *see Abstr.* 1022

CHEMICAL ANALYSIS 543/545

545.8 1033

Utilization of the radioactive isotope dilution procedures for special types of chemical problems. Quantitative determination of the three individual components of mixtures of dibenzyl sulfide, sulfoxide, and sulfone as an illustrative example. HENRIQUES, F. C., JR., AND MARGNETTI, C. *Industr. Engng Chem. (Analyt. Edit)* **38**, 476–7 (*Aug.*, 1946).

545.8 1034

Elementary isotopic analysis. Determination of oxygen. GROSSE, A. V., HINDIN, S. G., AND KIRSHENBAUM, A. D. *J. Amer. Chem. Soc.*, **68**, 2119 (*Oct.*, 1946).—A new isotopic method of determining O_2 in organic compounds has been developed from a modification of the isotope dilution principle introduced by Hevesy and Paneth. A known weight a of the substance ($x\%$ O_2) is equilibriated with a known volume of O_2 (b gm) containing a known amount of O_2^{18} ($m\%$) in excess of the normal concentration. The excess of O_2^{18} in the mixture after equilibration (n) is determined by the mass spectrograph. x is evaluated from the formula $x = [b(m-n)100]/an\%$. It has been tested satisfactorily with HCO_2H, $MeCO_2H$, $MeCH_2NO_2$, $(Et)_2O$. The average error is $\pm 3{\cdot}0\%$ but the method is capable of refinement; the maximum accuracy is obtained by using the same amount of O_2^{18} as there is O_2 in the sample. W. R. A.

545.822 1035

The use of heterochromous lines in spectrographic photometry. LEVY, S., AND CHRISTINE, O. W. *J. Opt. Soc. Amer.*, **36**, 503–6 (*Sept.*); *erratum*, 707 (*Dec.*, 1946).—The use of a pair of spectral lines with a large wavelength difference may result in large errors if the ordinary procedure is followed, but this can be greatly reduced by calibration of the transmission of the photographic emulsion for the two lines with a sample of known composition. J. W. T. W.

545.822 : 535.41 : 535.33.08 *see Abstr.* 816

545.844 : 541.183 *see Abstr.* 1028

CRYSTALLOGRAPHY 548

548.0 : 535.547 : 535.347 = 4 *see Abstr.* 835

548.0 : 537.228.1 : 534.133 1036

Properties of monoclinic crystals. MASON, W. P. *Phys. Rev.*, **70**, 705–28 (*Nov.* 1 *and* 15, 1946).—Ethylene diamine tartrate and dipotassium tartrate crystals have modes of vibration with zero temperature coefficients of frequency, and have high electromechanical coupling and high Q. Complete measurements of the 4 dielectric, 8 piezo-electric and 13 elastic constants of the latter crystal (DKT) are given, with a discussion of the method of measurement by the use of 18 properly oriented crystals. A.

548.0 : 537.529 1037

The orientation of electrical breakdown paths in single crystals. DAVISSON, J. W. *Phys. Rev.*, **70**, 685–98 (*Nov.* 1 *and* 15, 1946).—Investigations on the effect of tempera-

are in alkali halides suggest the existence of a path sequence random→[100]→[111]→[110]→[xxy] assumed by the direction of breakdown as the lattice energy or temperature increases. Star patterns of 12 non-primitive lattice directions were observed in LiCl and LiF. Mixed and impure crystals grown from the melt tend to exhibit high temperature path patterns at low temperatures. By extending the study at room temperature to crystals possessing different bonding and symmetry properties, general laws governing path orientation were established. It is shown that the possible path directions depend upon the macroscopic symmetry prevailing, and are apparently not influenced by the type of lattice bond. A.

548.0 : 539.32 = 3 1038

Elastic investigations on $NH_4H_2PO_4$ and KH_2PO_4. SWICKER, B., *Helv. Phys. Acta*, **19** (*Nos.* 6–7) 523–49 (1946) *In German.*—A polished cube of the crystal is set into forced elastic vibration by an oscillator-driven quartz crystal. There are then sinusoidal variations in density throughout the crystal, from which light (Hg green line) is diffracted. So that measurements can be made below room temperature the crystal is placed in a cryostat, the light being guided down to the crystal and up again by total-reflection prisms. For certain directions of propagation of the light in these crystals the diffraction pattern (normally a sixth-order curve) simplifies, and the elastic constants c_{ik} can be determined by measuring 9 intercepts. The values found for $NH_4H_2PO_4$ at 20°C are, in units of 10^9 dyne/cm^2: $c_{11} = 617 \pm 3$, $c_{33} = 328 \pm 2$, $c_{12} = 72 \pm 14$, $c_{13} = 94 \pm 10$, $c_{44} = 85 \pm 2{\cdot}5$, $c_{66} = 59{\cdot}2 \pm 0{\cdot}6$; and for KH_2PO_4: $c_{11} = 691 \pm 4$, $c_{33} = 556 \pm 3$, $c_{12} = 60{\cdot}0 \pm 0{\cdot}6$, $c_{13} = 122 \pm 12$, $c_{44} = 129{\cdot}0 \pm 1{\cdot}3$, $c_{66} = 60{\cdot}0 \pm 0{\cdot}3$. The temperature variation down to their respective Curie points (148 and 123°K) is shown by graphs, and is in general not great. For KH_2PO_4 $c_{66} = -c_{12}$ within the limits of error over the whole temperature range; it drops rapidly from the value 63·5 at 135°K to 11·5 at the Curie point. No consistent results could be obtained below the Curie points; $NH_4H_2PO_4$ shattered and KH_2PO_4 became non-transparent, though it recovered its transparency on warming up. The elastic moduli s_{ik} are calculated from the constants c_{ik} at 20°C, and the results are compared with those of other investigators. A. J. C. W.

548.0 : 539.32 : 549.211 1039

Elastic constants of diamond. BHAGAVANTAM, S., AND BHIMASENACHAR, J. *Proc. Roy. Soc. A*, **187**, 381–4 (*Nov.* 5, 1946).—A new (wedge) method [Abstr. 2565 (1944)] was employed to determine the elastic constants. The values are $c_{11} = 9{\cdot}5$, $c_{12} = 3{\cdot}9$, $c_{44} = 4{\cdot}3 \times 10^{12}$ dyne cm^{-2}. The values are also calculated, using force constants derived from spectroscopic data. The agreement is very good. L. S. G.

548.12 = 3 1040

Reformulation of crystallography. NIGGLI, P. *Experientia*, **2** (*No.* 9) 336–49 (1946) *In German.*—The many varieties of symbols in use for symmetry elements and operations are criticized for unsuitability and illogicality. In all groups with the same number z of equivalent points, the number of unit operations required to pass from one point to each of the others must also be z, but in the usual symbolisms the number of explicit symmetry elements or operations may be quite different. A new system is therefore proposed, with which problems of crystal symmetry and stereochemistry can be solved mathematically. An operation that transforms a point into itself in one step is called unary, in two steps, binary, in three, ternary, and so on. Each m-ary operation divides the z points into n cycles, and m and n are written as the subscript and exponent of the symmetry operation, denoted in general by f^n_m. The symbol for an i-fold axis is $\left[\frac{i}{i}\right]$, for an i-fold axis of rotary inversion $\left[\frac{-i}{-i}\right]$, and for an i-fold reflection-inversion axis $\left[\frac{i}{\bar{i}}\right]$. A mirror plane is thus $\left[\frac{-2}{-2}\right]$, and a centre of symmetry $\left[\frac{\bar{2}}{\bar{2}}\right]$. Rules are given whereby all the implicit symmetry elements can be written down for each crystal class. The full symmetry of 23 (T) would be written

$$\frac{1}{12}\left\{4{\cdot}2\left[\frac{3}{\bar{3}}\right]_3^4 + 3\left[\frac{2}{\bar{2}}\right]_2^6 + \left[\frac{1}{\bar{1}}\right]_1^{12}\right\},$$

indicating that there are 12 equivalent points, divided into 4 cycles of 3 each by 8 threefold axes equivalent in pairs, divided into 6 cycles of 2 by 3 twofold axes, and into 12 cycles of 1 by the operation of identity. Special attention is given to points (ordinarily said to be in special positions) that are transformed into themselves by a non-unary operation. The "isomers" possible with 8 points in each of the 32 point groups are treated in detail, and it is suggested that such considerations will be useful not only in crystallography but in chemistry. Space groups are not considered. A. J. C. W.

548.232.4 : 621.385.032.5 1041

A picturesque oxidation of molybdenum vacuum-tube leads. LIEBHAFSKY, H. A. *J. Appl. Phys.*, **17**, 901–2 (*Nov.*, 1946).

548.24 : 537.228.1 : 549.514.51 = 393 1042

Induced electric twinning in quartz crystals. VORMER, J. J. *Tijdschr. Ned. Radiogenoot*, **11**, 215–19 (*Nov.*, 1946) *In Dutch.*—The discovery that *CT*-sections to which wires had been soldered showed structure changes under the solder pointed to the possibility of inducing electric twinning below 573°C, and experiments showed that such twinning can be produced in *AT*-, *CT*- and *GT*-sections by combined heating and mechanical stress, at 70°–300°C, and that this induced twinning may be eliminated by heat treatment. Attempts at eliminating natural electric twinning were not successful so far. The experiments are described and micrographs shown. J. A. W.

548.7 1043

Theory of dipole interaction in crystals. LUTTINGER, J. M., AND TISZA, L. *Phys. Rev.*, **70**, 954–64 (*Dec.* 1 *and* 15, 1946).—It is shown that dipole arrays may be represented as vectors in a many-dimensional vector space. The classical dipole interaction energy is a quadratic form in the components of the dipole moments. Its calculation is reduced to the diagonalization of this form. The characteristic vectors are so called basic arrays. An arbitrary array may be decomposed into a linear combination of basic arrays, the energies are additive and may be obtained from the characteristic values of the quadratic form. The method is demonstrated by the complete solution of the characteristic value problem of a highly symmetric class of cubic arrays. The minimum energy arrays are obtained without and with an external magnetic field for the simple cubic, body-centred cubic, and face-centred cubic lattices. The results are in good qualitative agreement with experiments on Cs Ti alum [Abstr. 3255 (1936)]. Some discrepancies are attributed to quantum effects and to incomplete saturation (entropy $S > 0$). A.

548.73 : 531.717 1044

An X-ray method for measuring the thickness of thin crystalline films. EISENSTEIN, A. *J. Appl. Phys.*, **17**, 874–8 (*Nov.*, 1946).—When X-rays are scattered from a thin crystalline surface film overlying a crystalline base material, diffraction lines are observed from both materials. Equations are developed for the general case of (1) a flat sample and (2) a cylindrical sample expressing the ratio of line intensities from the two materials as a function of film thickness. A usable range of 10^{-6} cm to 5×10^{-2} cm is indicated. Experimental confirmation is found in the range 10^{-4} cm to 6×10^{-3} cm. A.

548.73 : 537.531 1045

The determination of X-ray diffraction line widths. SHULL, C. G. *Phys. Rev.*, **70**, 679–84 (*Nov.* 1 *and* 15, 1946).—The methods which have been suggested for correcting X-ray diffraction line widths for geometrical effects are reviewed. Experimental data are presented for two samples of finely-divided NiO and MgO which show that neither the Warren nor the Jones correction method is valid for these particular specimens. A direct Fourier transform procedure is given which permits calculation of the corrected diffraction line width for all experimental cases. A.

548.73 : 539.4.016.2 *see Abstr.* 1016

548.73 : 539.4.016.2 : 539.26 1046

Self-recovery of metals. BURGESS, W. G. *Nature, Lond.*, **159**, 203 (*Feb.* 8, 1947).—[See Abstr. 463 (1947)]. A short account, with references, of previous work on this subject.

548.734.3 : 539.215.4 1047

Determination of particle size by the X-ray powder method. JENSEN, A. T. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **20** (*No.* 8) 9 *pp.* (1943).—The particle-size broadening is obtained from the breadths of Debye–Sherrer lines given by the substance in its finely-divided and in its normal state, Gaussian intensity distributions being assumed. A. J. C. W.

548.734.52 1048

The determination of the orientation of single crystals on a Weissenberg goniometer. WOOSTER, N., AND WOOSTER, W. A. *Phil. Mag.*, **37**, 262–79 (*April*, 1946).—The limitations of existing methods are discussed and a method combining the advantages of both the Laue and oscillation methods is described. A Weissenberg goniometer is used without the screens which normally cover most of the film, so that an unusual type of pattern results. The crystal is oscillated about the usual axis of the goniometer and infiltered radiation is employed. An unscreened photograph of a diamond in a cutting tool is given. Two charts for interpreting the patterns are included. L. S. G.

548.735/.74 : 518.5 *see Abstr.* 720

548.735.44 1049

The simultaneous differential refinement of co-ordinates and phase angles in X-ray Fourier synthesis. BOOTH, A. D. *Trans. Faraday Soc.*, **42**, 617–19 (*Sept.–Oct.*, 1946).—The differential method of Fourier refinement [Abstr. 3005 (1946)] is extended to enable variation of phase angles to be incorporated. The treatment leads to a simple iterative process, which should prove considerably more rapid than existing methods. A.

548.735.44 1050

The accuracy of atomic co-ordinates derived from Fourier series in X-ray structure analysis. BOOTH, A. D. *Proc. Roy. Soc. A*, **188**, 77–92 (*Dec.* 31, 1946).—The expression for the electron density is

$$D = V^{-1}\sum_{h,k,l}|F|\cos\{\theta(h,k,l)-\alpha\}$$

and errors may be due to (1) experimental errors in the values of $|F|$, (2) h, k, l not running, in the summation, over an infinite range. The effect of each of these on the accuracy of D is investigated. Expressions for probable errors in co-ordinates are given in terms of the experimental errors usually encountered. Thermal agitation leads to a considerable decrease in accuracy. L. S. G.

548.736 = 3 1051

Crystal structure of Y(OH)$_3$. SCHUBERT, K., AND SEITZ, A. *Z. Naturforsch.*, **1**, 321 (*June*, 1946) *In German.*

548.736.33 1052

On the structure of SrCl$_2$, 6H$_2$O. JENSEN, A. T. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **17** (*No.* 9) 27 *pp.* (1940).—The space group is $C32$, $a = 7{\cdot}940$, $c = 4{\cdot}108$ kX; Sr in (a); 2 Cl in (d), $z = 0{\cdot}42$; 3 O in (e), $x = 0{\cdot}33$; 3 O in (f), $x = -0{\cdot}24$. A. J. C. W.

548.736.33 1053

The structure of SrCl$_2$, 2H$_2$O. JENSEN, A. T. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **20** (*No.* 5) 22 *pp.* (1942).—With axes oriented so that the space group is Ia, the axes are $a = 11{\cdot}76$, $b = 6{\cdot}38$, $c = 6{\cdot}66$ kX, $\beta = 72{\cdot}9°$. The atomic positions are Sr($\frac{1}{4}$, $\frac{1}{4}$, $\frac{1}{4}$), Cl(0·11, 0·10, 0·00), Cl(0·39, 0·10, 0·50), O(0·14, 0·40, 0·63), O(0·36, 0·40, 0·87) and the positions related to these by the symmetry elements. A. J. C. W.

548.736.33 1054

The structure of BaCl$_2$, 2H$_2$O. JENSEN, A. T. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **22** (*No.* 3) 22 *pp.* (1945).—The space group is P$2_1/n$, $a = 6{\cdot}738$, $b = 10{\cdot}86$, $c = 7{\cdot}136$ kX, $\beta = 90{\cdot}57°$. The atomic positions are Ba(0·045, 0·217, 0·147), Cl(0·851, 0·084, 0·781), Cl(0·641, 0·105, 0·289), O(0·36, 0·15, 0·93), O(0·23, 0·15, 0·49) and the positions related to these by the symmetry elements. A. J. C. W.

548.736.442.6 1055

Temperature changes in the crystal structure of barium titanium oxide. MEGAW, H. D. *Proc. Roy. Soc. A*, **189** (*No.* 1017) 261–83 (1947).—Barium titanium oxide, which is tetragonal at room temperature, changes at about 120°C to a cubic structure. This change has been followed in detail by means of X-ray powder photographs taken in a 19 cm powder camera at intervals of a few degrees. The unit cell, which contains the formula number of atoms, retains its identity throughout the transition, and the atomic parameters are unaltered. The change is simply in the axial lengths, and these vary continuously with the temperature, more rapidly near the transition point. There is a sharp discontinuity in the linear expansion coefficients at the transition point, and a marked increase in the volume expansion coefficient, which is probably, though not certainly, discontinuous. The transition suggests a typical λ-point change. Co-existence of cubic and tetragonal structures, in proportions depending on the temperature, occurs over a range of some degrees near the transition point. The structure may have a second transition point somewhere below −183°C and become cubic again. It is argued that the room-temperature structure can only be explained by the existence of directed bonds, and that the breaking of these bonds with increasing temperature is responsible for the 120°C transition. The low-temperature transition is explained by postulating a more complete set of bonds,

obably an octahedral complex, which partially breaks wn at this temperature to give the square formation served in the room-temperature structure. The othesis that directed bonds exist, whatever their origin, used for a tentative explanation of anomalous varia- ns of intensity of the X-ray lines observed at tempera- es near the transition point. A.

.737 1056

The crystal structure of some molecular complexes of 4'-dinitrodiphenyl. I. The complex with 4-hydroxy- henyl. SAUNDER, D. H. *Proc. Roy. Soc. A*, **188**, 31–51 c. 31, 1946).

.737 1057

The crystal structure of meta-dinitrobenzene. ARCHER, E. M. *Proc. Roy. Soc. A*, **188**, 51–62 (*Dec.* 31, 1946).

548.737 1058

The crystal structures of two polyamides ("nylons"). BUNN, C. W., AND GARNER, E. V. *Proc. Roy. Soc. A*, **189**, 39–68 (*March* 27, 1947).

548.737 : 541.6 *see Abstr.* 1030

548.74 : 537.533.73 = 4 *see Abstr.* 889

MINERALOGY 549

549.211 : 539.32 : 548.0 *see Abstr.* 1039

549.514.51 : 537.228.1 : 548.24 = 393 *see Abstr.* 1042

GEOPHYSICS 55

.34 1059

Deep-focus and intermediate earthquakes in the East ies. VENING MEINESZ, F. A. *Proc. K. Ned. Akad. t.*, **49** (*No.* 8) 855–65 (1946).

.341 = 5 1060

The interpretation of the *F*-phase. VALLE, P. E. *Ric. . Ricostruz.*, **16**, 664–7 (*May–June*, 1946) *In Italian.*

.341 : 534.213 1061

On the theory of seismic and seismoelectric phenomena a moist soil. FRENKEL, J. *J. Phys., USSR*, **8** (*No.* 4) -41 (1944).—A study is made of the elastic properties a dry soil and of how these properties are modified en the soil becomes moist. A system of 5 equations btained for the motion of the soil, taking into account friction between the solid and liquid phases. The ations are linearized and used to investigate the pagation of longitudinal and transverse vibrations in soil. The simplest case, that of longitudinal harmonic ves, is studied in detail. Associated with these waves an electrification of the soil and a formula is deduced the strength of the electric field. L. S. G.

.37/.38 1062

Electric quadrupole of the earth. ELSASSER, W. M. *s. Rev.*, **70**, 438–9 (*Sept.* 1 *and* 15, 1946).—[See Abstr. 6 (1946)].

.46 : 532.593 1063

Study of ocean swell. BARBER, N., AND URSELL, F. *ture, Lond.*, **159**, 205 (*Feb.* 8, 1947).—Observations h the apparatus previously described [Abstr. 3247 46)] indicate that the swell travels with the classical up velocity appropriate to its period on arrival. The gest period exhibited by swell due to a distant storm proportional to the maximum wind velocity. Swell been received from storms 2 800 and 6 000 miles tance.

.46.018.2 : 531.787.4 1064

The measurement of pressure on the sea bed. RICHARD- , E. G. *Phil. Mag.*, **37**, 25–32 (*Jan.*, 1946).—A rubber phragm manometer for measuring the pressure is cribed. The pressure of waves rather than tidal tion had to be recorded and for this the principle of equalization chamber and pressure leak was used. instrument is calibrated by using classical hydro- amical theory. The results of some experiments de in the English Channel illustrate the use of the paratus for wave-height recording. Pressure records ships were also obtained. L. S. G.

.463 : 535.36 1065

Transparency of ocean water. JENKINS, F. A., AND WEN, I. S. *J. Opt. Soc. Amer.*, **36**, 617–23 (*Nov.*, 1946).—Describes measurements of the range of visibility of (*a*) a white disc and (*b*) a light source under water at various depths in the ocean off San Diego. The nature of the scattering particles and their size were studied. It is concluded that measurements on water transported to the laboratory give reliable results. J. W. T. W.

551.482.2.018.4 : 536.512 = 397 1066

Water-temperature determination in rivers. NYBRANT, G. *Tekn. Tidskr.*, **76**, 1073–7 (*Oct.* 26, 1946) *In Swedish.* —The accuracy of temperature measurements in general, by resistance methods and by mercury thermometers, is discussed and the requirements of measurements in rivers near hydropower stations are stated. The mercury thermometers used in Sweden are encased in a container, with influx regulator, and the design of the whole apparatus is described, both for such which are permanently on site and only lifted for reading and for portable instruments. The corrections are discussed in detail. J. A. W.

551.495.01 1067

Dr. Löwy's theory of ground-water accumulation. KEEN, B. A. *Phil. Mag.*, **37**, 502–4 (*July*, 1946).—[See Abstr. 2191 (1946)].

METEOROLOGY 551.5

551.508.5 : 621.317.39 1068

Continuous wind recorders. IVES, R. L. *Rev. Sci. Instrum.*, **17**, 416–24 (*Oct.*, 1946).—A multiple-unit system incorporating wind speed and direction transmitters and graphic recorders is described, any number of receivers being possible. Transmitters are of the contacting type; for speed a contact is made each tenth of a mile, and for direction a potential divider varies the current transmitted. The receiver is of standard type, showing direction with edge marks for each speed impulse which have to be added on reading. Both 6- and 2-wire systems are used, the former using separate circuits for the transmitters and the latter using 2 frequencies for 2 transmitters, with filters and rectifiers at the receiver. E. H. W. B.

551.510.42 : 539.16 1069

Results of atmosphere analyses done at Tulsa, Oklahoma, during the period neighboring the time of the second Bikini atomic bomb test. FEARSON, R. E., ENGLE, A. W., THAYER, J., SWIFT, G., AND JOHNSON, I. *Phys. Rev.*, **70**, 564 (*Oct.* 1 *and* 15, 1946).—Activities of samples collected on July 26 and Aug. 30 indicated that the substances were the active deposits of radon and thoron. That collected on July 28 appeared to be a new rare radioactive gas of atomic number 86, with a ½-life of 82 min.

551.510.42 : 539.16 1070

The ionization of the atmosphere in the New York area before and after the Bikini atom bomb test. HESS, V. F., AND LUGER, P., JR. *Phys. Rev.*, **70**, 564–5 (*Oct.* 1 *and* 15, 1946).—No significant increase of ionization was detected in the period June 29 to July 10, using a 13 l ionization chamber.

551.510.42 : 539.16 1071

Effort to observe anomalous gamma-rays connected with atomic bomb test of July 1, 1946. WEEKES, E. D., AND WEEKES, D. F. *Phys. Rev.*, **70**, 565 (*Oct.* 1 *and* 15, 1946).—No significant increase of counting rate was detected in the period June 25 to July 26, using a Geiger counter. The locality was 100 miles NW of Houston, Texas [see Abstr. 3198 (1946)].

551.510.535 1072

Atmospheric tides in the ionosphere. I. Solar tides in the F_2 region. MARTYN, D. F. *Proc. Roy. Soc. A*, **189** (*No.* 1017) 241–60 (1947).—A theory, based on solar tides, is advanced to explain the anomalous seasonal, diurnal and geographical variations of F_2 region ionization. It is shown that the horizontal winds due to these tides must cause electrons to move along the lines of the earth's magnetic field. The resultant motion has a vertical component. Account is taken of polarization of the medium by the "dynamo" electric forces. Owing to viscosity the vertical motion decreases upwards in the F_2 region. Application of the equation of continuity shows that the F_2 region becomes greatly distorted. A "longitude effect" is found to arise by reason of the asymmetry of the earth's magnetic field. The theory is used to explain the high F_2 ionization densities found in low latitudes, and the high values of h'_{F_2} at noon near the equator. It is also used to explain the afternoon and night-time increases in ionization found at certain locations. It is suggested that the effective recombination coefficient in F_2 is much lower than the generally accepted values. It is shown that Appleton and Weekes's evidence of lunar tidal effects in the E region [Abstr. 2654 (1939)] does not conflict with the "dynamo" theory of magnetic variations or with Pekeris's calculations [Abstr. 1123 (1937)]. Observational evidence of the existence of solar tides in the F_2 region is presented. A.

551.510.535 : 537.564 *see Abstr.* 898

551.510.535 : 537.568 *see Abstr.* 899

551.510.535 : 538.566.3 *see Abstr.* 924

551.513.1 1073

On fluctuations of pressure and temperature in the atmosphere. ANANTHAKRISHNAN, R. *Proc. Indian Acad. Sci. A*, **24**, 393–425 (*Nov.*, 1946).—Pressure and temperature fluctuations in the atmosphere are critically reviewed. Excluding non-adiabatic processes, all changes are essentially due to horizontal and vertical movements in the atmosphere. Advection can give rise to large changes of pressure, especially in middle latitudes. Rossby's theory is not uniformly satisfactory in explaining effects, owing to its neglect of horizontal advection of pressure and horizontal convergence and divergence of wind velocity. W. R. A.

551.513.1 1074

Transport of heat and other properties by atmospheric turbulence. PRIESTLEY, C. H. B., AND SWINBANK, W. C. *Nature, Lond.*, **159**, 61 (*Jan.* 11, 1947).

551.513.1 : 551.543 *see Abstr.* 1076

551.521.1 : 523.77 *see Abstr.* 729

551.524.7 1075

Radiative equilibrium in the ionosphere. WOOLLEY, R. V. D. R. *Proc. Roy. Soc. A*, **189** (*No.* 1017) 218–4 (1947).—The equations of radiative equilibrium in th earth's atmosphere are examined with special referen to high temperatures in the ionosphere arising out of radiation balance between heavy ultra-violet absorptio in the ultra-violet and relatively weak infra-red emissio It is suggested that while molecular oxygen is the princip ultra-violet absorption agent at heights below 250 kn at greater heights the absorption is mainly due to atom oxygen. Similarly, it is suggested that while wat vapour is the principal infra-red radiator at a height 100 km, at much greater heights water vapour is abse and the temperature is effectively controlled by negativ ions at a height of 250 km and perhaps by dust at muc greater heights. The gravitational equilibrium of dissociating oxygen atmosphere is discussed, referen being made to the effects of collisions and of absorptio of the dissociating radiation.

551.543 : 551.513.1 107

Atmospheric pressure changes. PRIESTLEY, C. H. B *Nature, Lond.*, **158**, 914 (*Dec.* 21, 1946).

551.582.2(48) = 397 107

The seasons in Scandinavia. NORDIN, A. V. *Tekn Tidskr.*, **76**, 1057–64 (*Oct.* 26, 1946) *In Swedish.*— Summer is defined as the period in which mean dail temperature exceeds 10°C, winter as that in whic m.d.t. < 0°C, spring and autumn being the inter mediates. A seasonal factor is defined as mea temperature × number of days ÷ 100. Tables are given based on the period 1901–30, of these values, togethe with precipitation, for a number of stations in Sweden Norway, Finland and Denmark, selected with specia consideration of geographical characteristics, latitude coast and inland sites. J. A. W.

551.590.21 : 523.746 = 3 *see Abstr.* 728

551.594 1078

A theory of the fundamental phenomena of atmospheric electricity. FRENKEL, J. *J. Phys., USSR*, **8** (*No.* 5) 285–304 (1944).—A new quantitative theory of the circulation of electricity in the lower atmospheric layers and in the upper layers is developed. This is based on some ideas in colloidal electrochemistry. Water drops or ice crystals in the weakly ionized air are charged negatively and constitute the dispersive medium. The sinking of the drops under gravity leads to a polarization of the cloud, with a uniform downward electric field. This produces a conduction current compensating the convection current set up by the motion of the charged drops. The steady field has a value of 30 to 150 volts/cm. The electrical field created by the cloud, and its image, is calculated, and the total charge on the earth is found to be zero. The numerical estimates of the field strength inside and outside the cloud agree well with experiment. Thunder clouds are studied and a general method for determining the electric field of clouds is outlined. L. S. G.

551.594.12 1079

The electrical charge on precipitation at various altitudes and its relation to thunderstorms. GUNN, R. *Phys. Rev.*, **71**, 181–6 (*Feb.* 1, 1947).—The free electrical charges on individual precipitation particles were measured by an induction method that avoided touching them. In a weak cold front exhibiting no thunderstorm activity, positive charges averaging 0·033 e.s.u. were observed from 10 000 to 26 000 ft. Negative charges averaging 0·04 e.s.u. were measured from the surface up to 20 000 ft. The electric field at the surface of many of the particles was an appreciable fraction of the breakdown field for air, showing that powerful electrifying agencies exist even under rather quiet frontal conditions.

ctric field measurements showed that the particle rges were largely neutralized by nearby charges; the oval of this will immediately produce thunderstorm tric fields and potentials. A.

.594.13 1080
ome experiments relating to the electrical conductivity he lower atmosphere. WAIT, G. R. *J. Wash. Acad.* , **36**, 321–43 (*Oct.*, 1946).

:594.22 : 621.395.5 = 397 1081
remarkable thunderstorm at Kolmården. LINDSTRÖM, AND YGBERG, E. R. *Tek. Medd. K. TelegrStyr.* . 2) 80–4 (1946) *In Swedish.*—[Abstr. 1015 B (1947)].

.594.221 1082
requency of occurrence of lightning flashes to earth. GOLDE, R. H. *Quart. J. Roy. Met. Soc.*, **71**, 89–109 (*Jan.–April*, 1945).—Published information on the number of lightning flashes to earth is found to be inadequate, and indirect estimates, which can be deduced from various statistical investigations (damage to buildings, forest fires, human casualties), are shown to vary over a wide range. A new estimate is obtained by means of a census of the number of flashes to earth experienced by two groups of persons totalling in number 254 and covering an aggregate of over 4 000 years. An average number of 6 lightning flashes to earth per square mile per annum is deduced for England. The audible impression of a sharp crack which precedes the ordinary sound of thunder is discussed and this is suggested to offer possibilities for future investigation of the problem under review. R. H. G.

BIOLOGY 57/59

.088.5 : 519.2 1083
The probabilistic approach to the effects of radiations variability of sensitivity. OPATOWSKI, I. *Bull. th. Biophys.*, **8**, 101–19 (*Sept.*, 1946).—On the assump- that the death (or other observable change) of an diated small organism is due to the occurrence of n t actions (e.g. ionizations) in a sensitive region, the portion $Y_n(t)$ of organisms killed by time t can be culated. An elaborate mathematical formulation is en, taking account of the possibilities of recovery from iation damage, or of change in sensitivity, occurring ing irradiation. The survival curves obtained in ppinger's (1928) experiments on the killing of *Ascaris* s by X-rays are interpreted on the basis that $n = 2$ that the eggs increase in sensitivity during the period the experiment. D. E. L.

.088.74 : 621.396.615.17 1084
versatile square wave nerve stimulator. GUYTON, C. *Rev. Sci. Instrum.*, **17**, 553–6 (*Dec.*, 1946).

EDICAL SCIENCE . HUMAN PHYSIOLOGY 61

.843.32 1085
Response curve of the yellow receptors of the human ea. HARTRIDGE, H. *Nature, Lond.*, **158**, 946–8 (*Dec.* 1946).

.843.34 1086
Binocular colour combinations. PICKFORD, R. W. *ture, Lond.*, **159**, 268–9 (*Feb.* 22, 1947).—The fusion of o colours, presented separately to each eye, was vestigated, and the degree of combination achieved for ious colours tabulated and analysed. The results ow that complementaries are more difficult to combine, l support a 4-colour theory rather than the Young– lmholtz theory.

.843.37 1087
The kinetics of visual dark adaptation. JAHN, T. L. *Opt. Soc. Amer.*, **36**, 659–65 (*Nov.*, 1946).—Proposes heory of the photochemical reactions between visual rple and its products which gives results in agreement h the observed facts of dark adaptation. J. W. T. W.

.843.6 1088
A theory of the Stiles and Crawford effect. O'BRIEN, B. *Opt. Soc. Amer.*, **36**, 506–9 (*Sept.*, 1946).—Suggests at the Stiles–Crawford effect of dependence of the nsitivity of retinal cones on the angle of incidence of light on the retina may be explained on the assump- n of total internal reflection of light within the ndrical cone. J. W. T. W.

612.843.612 1089
Contrast thresholds of the human eye. BLACKWELL, H. R. *J. Opt. Soc. Amer.*, **36**, 624–42 (*Nov.*, 1946).—Experimental data are presented representing approximately 450 000 responses made by trained observers under laboratory conditions. Contrast thresholds are presented for stimuli brighter and darker than their background, and for two values of stimulus exposure. In each case, wide variations in stimulus contrast, stimulus area, and adaptation brightness were studied. A.

612.843.63 1090
Visual thresholds of steady point sources of light in fields of brightness from dark to daylight. HECHT, S. *J. Opt. Soc. Amer.*, **37**, 59 (*Jan.*, 1947).—See Abstr. 3029 (1946). A better fit to the data is obtained by using 2 curves, according to accepted theories.

612.843.63 1091
Flash visual acuity. MARTIN, L. C., AND KANIOWSKI, W. *Nature, Lond.*, **159**, 25–6 (*Jan.* 4, 1947).—Some results are quoted of measurements of visual acuity made with illumination lasting only for periods of 2 to 700 msec. They are not consistent with the equation of Niven and Brown [Abstr. 1455 (1945)] and possible explanations are discussed.

614.7–084.48 1092
Recent ozone investigations. EWELL, A. W. *J. Appl. Phys.*, **17**, 908–11 (*Nov.*, 1946).—Continuation of previous work [Abstr. 830 B (1943)] on ozone production by electric lamps. A.

615–073.75 : 778.33 *see Abstr.* 1097

615.81 : 621.383 : 621.397.9 1093
Sensory aid for the blind. CRANBERG, L. *Electronics*, **19**, 116–19 (*March*, 1946).—[Abstr. 1056 B (1947)].

615.831 : 621.321 1094
Artificial sunshine. PRIDEAUX, G. F. *Gen. Elect. Rev.*, **49**, 40–4 (*Nov.*, 1946) See also *Illum. Engng, N.Y.*, **41**, 762–74 (*Nov.*, 1946).—[Abstr. 965 B (1947)].

615.849 1095
Energy absorption and integral dose in X-ray and radium therapy. A review. WILSON, C. W. *Radiology*, **47**, 263–78 (*Sept.*, 1946).—The concepts of the total energy absorption of the patient's body during irradiation and the integrated dosage are discussed in relation to practical therapy, together with other factors which will need future consideration, e.g. effect of dosage rate, inhomogeneity of the body and variable susceptibility of different parts of the body. To date, the "tolerance

dose" for an operator, as laid down in protective recommendations, does not take into consideration the conditions, such as dosage rate, under which the radiation is actually received. The methods employed to determine the energy absorption and integral dose for X-rays and Ra, employing Mayneord's celluloid and wa life-size "man," are dealt with in detail. B. J. I

616–073.75 : 537.531 *see Abstr.* 885, 886

616–073.755.2 : 771.534.553 : 778.333 *see Abstr.* 1099

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666 : 536.413 : 532.13 *see Abstr.* 764

666.11 : 621.3.011.5 : 537.226.31 *see Abstr.* 871

677 : 539.216 : 539.41 *see Abstr.* 1017

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77.023.4 : 621.317.351 : 771.531.3 : 778.3 *see Abstr.* 1096

771.351 : 535.317 *see Abstr.* 810

771.531.3 : 77.023.4 : 621.317.351 : 778.3 *see Abstr.* 1096

771.534.553 : 616–073.755.2 : 778.333 *see Abstr.* 1099

771.534.56 : 621.317.351 : 778.37 *see Abstr.* 1102

778.3 : 771.531.3 : 77.023.4 : 621.317.351 1096

The photographic recording of cathode ray tube screen traces. The choice of emulsions and developers. HERCOCK, R. J. *Photogr. J.*, **86 B**, 138–42 (*Nov.–Dec.*, 1946).

778.33 : 615–073.75 1097

Eliminating scattered radiation in medical X-ray photographs. OOSTERKAMP, W. J. *Philips Tech. Rev.*, **8**, 183–92 (*June*, 1946).—The criterion for the value of methods for the elimination of scattered radiation is the "selectivity," i.e. the ratio between the attenuation factor for the scattered rays and that for the primary radiation, producing the desired X-ray shadow picture. A survey is given of the usual methods of eliminating scattered rays and one of the most important, the Potter–Bucky diaphragm, is discussed in detail. The properties of various forms of this diaphragm are compared, to provide information on their most efficient construction. A.

778.33 : 620.179.152 1098

The quantitative interpretation of radiographs in terms of mechanical properties. CARR, L. R. *J. Sci. Instrum.*, **23**, 221–7 (*Oct.*, 1946).—[Abstr. 864 B (1947)].

778.333 : 771.534.553 : 616–073.755.2 1099

Measurement of the resolving power of intensifying screens. VAN ALLEN, W. W., AND MORGAN, R. H. *Radiology*, **47**, 166–74 (*Aug.*, 1946).—An instrument is described and illustrated by which exposures are made *via* an adjustable linear aperture, between opaque blocks of Pb alloy, the width of the slit being varied laterally between exposures, so that the image consists of a number of line groups, separated by unexposed spaces the same width as the lines. The method of use is described and curves so obtained are related in terms of resolving power and contrast for varying film density The resolving powers of several commercial screens hav been measured, in relation to various film densities an developmental conditions. B. J. I

778.37 110

High speed camera. BAIRD, K. M. *Canad. J. Res. A* **24**, 41–5 (*July*, 1946).—An ultra high speed motio picture camera is being developed to assist research o high speed aerodynamics, ballistics, etc. Ten objectiv lenses are uncovered in turn by a radial slot in a rotatin shutter disc, and this process is repeated without paus by succeeding slots in the disc. Images formed by th lenses are enlarged, then projected by rotating prism (one for each lens) on to a strip of film fixed to a rotatin drum. The photographs appear in rows of ten across the width of the film, but each is slightly displaced relatively to the next, in the direction of motion of th film. The film moves on by one image diameter whil each set of ten images is being printed. This arrange ment increases the possible frequency of the photograph above that of conventional methods, and makes les critical the compensation for film movement by th rotating prisms. The film is used up in one rotation o the drum, which with the shutter disc and the prisms i accelerated to constant speed before the exposure begin. These speeds are 9 000, 30 000 and 60 000 r.p.m respectively for a picture frequency of 200 000 per sec The object photographed is illuminated by a shor brilliant flash of light. Photographs made at 64 000 pe sec are reproduced to show the performance of simplified model of the camera without rotating prism or enlarging lens. No details of mechanical design ar given. S. T. H

778.37 : 621.317.351 110

The photography of high-speed traces with the sealed-of glass cathode ray tube. NETHERCOT, W. *Photogr. J.* **86 B**, 159–64 (*Nov.–Dec.*, 1946).

778.37 : 621.317.351 : 771.534.56 110

Photographic aspects of high-speed recording. BERG W. F. *Photogr. J.*, **86 B**, 154–8 (*Nov.–Dec.*, 1946).